CHAPTER 5: ENVIRONMENTAL CONSEQUENCES

The U.S. Department of Energy (DOE) has assessed the effects from constructing and operating the proposed Spallation Neutron Source (SNS) on the environment at each of the four alternative sites (see Chapters 3 and 4). The potential effects described in this chapter are in addition to those that exist from other operations at each of the potential sites. DOE assessed these effects by analyzing the proposed action at each of the four alternative sites; assessing the actions that could have effects; identifying the nature of these effects; and quantifying (if possible) the magnitude of the effects.

The potential environmental impacts that could result from implementing the proposed action are described in this chapter. The proposed action could be implemented through any one of the four major siting alternatives: Oak Ridge National Laboratory (ORNL) site (Preferred Alternative), Los Alamos National Laboratory (LANL) site, Argonne National Laboratory (ANL) site, and Brookhaven National Laboratory (BNL) site. Impacts that could result from the No-Action Alternative are also described. All impacts from these alternatives are described in terms of the various aspects of the affected environment that would be expected to change over time as a result of their implementation. The impacts from the No-Action Alternative are those that would result from maintaining the status quo with respect to neutron sources. The No-Action Alternative impacts provide a basis to which the impacts expected from the other alternatives can be compared.

The CEQ regulations in 40 CFR 1501.2 require integration of the NEPA process with other planning for proposed actions "…at the earliest possible time…". In accordance with this requirement, the EIS process was initiated during the conceptual design phase of the SNS project. As a result, many of the design details normally established during later Title I and II design have not been established for the proposed SNS. These details include the final routes of access roads and utility corridors to the proposed SNS sites at the four national laboratories. In addition, the final locations of the retention basin remain uncertain. As a result, the potential effects of SNS construction and operational activities on the environment in such areas cannot be assessed realistically at this point in time. Thus, the results of such assessments are not included in the text of this chapter.

If a final site for the proposed SNS is selected, the final locations of the retention basin, roads, and utility corridors would be established at the host national laboratory. To the maximum extent possible, such areas would be delineated to avoid effects on known environmental features such as cultural resources, wetlands, and natural areas. In addition, the potential effects of the proposed action on the overall environment in these areas would be assessed. If effects are identified, appropriate mitigation measures would be implemented. Details of the mitigation measures would be included in the Mitigation Action Plan (MAP) [refer to Section 1.4]. The assessment and mitigation measures would be implemented prior to the initiation of ground-disturbing activities in the delineated areas.

5.1 METHODOLOGY

The environmental impact assessment methodologies discussed in this section address the full range of issue areas pertinent to the sites considered in the final Environmental Impact Statement (FEIS). These resource areas are land resources, air quality and noise, water resources, geology and soils, biotic resources, cultural resources, socioeconomics, human health, support facilities, and waste management. Each of the pertinent issue area methodologies is presented in detail in the following subsections.

5.1.1 GEOLOGY AND SOILS

The impacts assessments for geology and soils identify resources that may be affected by the construction and operation of the SNS and the presence of natural conditions that may affect the integrity and safety of the project. Geological resources include mineral and energy resources (coal, oil, and mineral reserves); unique geologic features; geologic hazards (earthquakes, faults, volcanoes, landslides, subsidence, and karst development); and soil resources. Mineral and energy resources are evaluated from historical activities and accounts of past production to assess the potential for future exploitation. Geologic features would identify unique or scenic topographic features or rock units that may contain mineral or energy resources. Earthquake potential is evaluated on the basis of past events and the locations of capable faults. Areas of past mass movement and conditions favorable to mass movement, such as excessive slopes and soils susceptible to liquefaction, are identified. The evaluation of soil resources includes natural earth materials, prime farmland, and erosion control.

The impacts assessments for each alternative involve locating geologic and soil features of concern. A quantitative estimate of radionuclides accumulated in the soil mass during operations of the SNS is conducted to determine levels of radioactivity in the subsurface. These levels would not be expected to vary significantly due to site-specific conditions; however, the fate and transport of radionuclides is greatly affected by the natural environment at each alternative site. A study of transport of nuclides and exposure potential is performed for the ORNL site and used as a basis for qualitative comparison to the alternative sites. Impacts are identified if the proposed site at each alternative is located within any unique geologic feature that would be subjected to irreversible physical disturbance by the project. Potential operational activities conducted in areas prone to geologic or natural hazards are assessed and presented. The geology and soils impacts are discussed qualitatively for each alternative, and mitigation measures to reduce impacts from geology and soil resources are identified.

5.1.2 WATER RESOURCES

The assessment of potential impacts to water resources includes surface water bodies, floodplains, and groundwater resources and quality. The impacts assessment includes the evaluation of water availability, water quality, drainage channel alterations, and flooding potential.

Surface waters include creeks, streams, rivers, and lakes; they are described in terms of general flow characteristics and the affected environment of each water body. Construction impacts are evaluated in relation to erosion control and floodplains encroachment. Emphasis is placed on the alteration of water bodies potentially impacted during the operational phase of the proposed SNS by increased flow within the watershed. Surface water quality is compared to existing baseline conditions and the type, rate, and concentration of potential discharge constituents. Environmental consequences are related to construction impacts in the watersheds, increased discharge to drainage channels, and other parameters with the potential to further degrade existing water quality in violation of existing National Pollution Discharge Elimination System (NPDES) permit limits.

Floodplains include any lowlands that border a stream and encompass areas that may be covered by the stream's overflow during flood stages. Any facility within a 100-year floodplain is considered a critical action.

Groundwater includes water that occurs below the water table in saturated, unconsolidated regolith and soil or in fractures and porous bedrock. Aquifers are saturated strata containing groundwater resources. Availability of groundwater varies widely among the siting alternatives because it is a function of both hydraulic characteristics of the aquifer and the competition in groundwater development and use by other consumers. The potential effects to groundwater availability are assessed for each alternative by evaluating whether the proposed project would increase groundwater withdrawal in an area, could potentially decrease groundwater levels in an area causing substantial depletion, or could exceed available supply limits. Potential effects on groundwater quality are associated with radiological contamination over the operational life of the SNS. The potential for contaminant migration to potable aquifers and other water sources is assessed and compared to federal and Nuclear Regulatory Commission (NRC) standards. Parameters with the potential to further degrade existing groundwater quality are identified for each alternative.

5.1.3 CLIMATOLOGY AND AIR QUALITY

The air quality assessment evaluates the environmental consequences of criteria pollutants that could be emitted during construction or operational activities at the four proposed SNS sites. Air quality impacts are evaluated within the context of the Clean Air Act as amended, the Environmental Protection Agency's (EPA's) National Primary and Secondary Ambient Air Quality Standards (40 CFR 50), and state-proposed or state-adopted standards and guidelines. Air quality concentrations from modeling proposed site emission rates are used to determine those effects of pollutants at each site.

Air quality impacts during construction are not strictly quantified, but fugitive dust and construction vehicle emissions are predicted to be minimal with temporary elevations of levels comparable to local construction and land fill operations.

The primary nonradiological airborne release during operations at the proposed SNS would be combustion products derived from the use of natural gas. Criteria pollutant emission rates for ten small boilers are derived from EPA's "Emission Factors for Stationary Sources" (AP-42).

EPA's Screen 3 model is then employed to calculate the SNS impact to air quality by comparing projected ambient concentrations from calculated emissions against the National Ambient Air Quality Standards (NAAQS). Conversion factors are applied to predict concentrations for longer periods corresponding to NAAQS parameters. Background (baseline) concentrations (based upon maximum ambient-monitored concentrations at nearby locations to each site) were also added to the model projected maximums before final comparison to the NAAQS. Air quality effects of periodic discharges from diesel backup generators are stated to be negligible.

5.1.4 NOISE

The on-site and off-site acoustical environments may be impacted during facility construction and operation. General construction noise sources that may affect nearby receptors were taken from the reference Golden et al, 1980. This source provides noise levels anticipated at varying distances (up to 400 ft) from the construction activity. Since the nearest public accommodation is more than 400 ft from any construction, these values were used as conservative baselines for expected noise levels during construction. These noise levels are then compared to noise levels commonly encountered by the general public as taken from Harris et al, 1992.

Operation of the SNS would generate some noise, caused particularly by site traffic and cooling towers. In general, sound levels are stated to be characteristic of a light industrial setting. Effects upon residential areas are attenuated by the distance from the SNS and by a forested buffer zone. On-site, the level of noise from the SNS is stated to be typical of accelerator facilities, and any effects are stated to be negligible when compared to ambient levels.

5.1.5 ECOLOGICAL RESOURCES

The assessment of potential impacts to ecological resources is performed for terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Potential impacts are assessed by evaluating changes to the baseline environment at each of the potential sites (no action) that could result from construction and operation of the SNS. The baseline conditions at the sites are descriptive and qualitative in nature. Assessing the potential impacts resulting from construction and operation of the SNS involves determining the amount of habitat lost or disturbed. Mitigation and monitoring strategies are discussed as appropriate.

5.1.5.1. Terrestrial Resources

Potential impacts to terrestrial resources include loss and disturbance of wildlife and wildlife habitat. Two important considerations in assessing the potential effects on habitat are the presence and regional importance of affected habitats and the size of the habitat area temporarily or permanently disturbed.

Potential impacts on terrestrial plant communities resulting from project activities are evaluated by comparing regional vegetation information to proposed land requirements for construction and operation of the SNS. Impacts to wildlife are based on plant community loss, which is closely related to wildlife habitat. The loss of important or sensitive species or habitats is more significant than the loss of species or habitats that are regionally abundant. Evaluation of the effects of construction and operation of the SNS on terrestrial resources involves looking at the disturbance, displacement, and loss of wildlife and wildlife habitat in the vicinity of the alternative sites for the SNS as well as the surrounding area.

5.1.5.2. Wetlands

Potential effects on wetlands caused by construction of the SNS include encroachment on the wetland and degradation of the wetland caused by activities outside of the wetland, such as soil erosion, siltation, and sedimentation. Operational effects may occur from effluents released from the SNS. The assessment of potential effects on wetlands includes determining whether construction of the SNS would encroach on or indirectly affect an existing wetland and evaluating the potential effects from increased runoff of water and effluents released from the SNS during operations.

5.1.5.3. Aquatic Resources

Effects to aquatic resources depend on the nature of the water body and the aquatic life present. Potential effects due to habitat loss, sedimentation, increased flows, and introduction of waste heat are discussed in a qualitative manner for the aquatic resources at each of the alternative sites.

5.1.5.4. Threatened and Endangered Species

Information on threatened and endangered species at each of the alternate sites comes from informal consultation with the U.S. Fish and Wildlife Service, state agencies, and surveillance surveys conducted at each site (See Sections 4.1.5.4, 4.2.5.4, 4.3.5.4, and 4.4.5.4). The site-specific surveillance surveys were done to obtain an initial indication of whether protected species were present at each site. Effects are assessed by determining if construction of the SNS would disrupt existing threatened or endangered species or encroach on habitat critical for the survival of a protected species.

5.1.6 SOCIOECONOMIC AND DEMOGRAPHIC ENVIRONMENT

Socioeconomic impact analysis assesses the environmental consequences of demographic and economic changes resulting from the implementation of the SNS at each of the alternative sites. Increasing the level of activity at the four alternative sites could potentially burden existing community services and create additional demands on available housing stock. The primary determinants of community impacts are changes in the economic base and demographic composition usually associated with the in-migration of new workers. Assuming that total employment would rise from a proposed activity and that some of this increase could be associated with in-migration, the demand for local services could rise. The new workers and their families would require public services (for example, schools and health care) and, thus, create conditions for an expansion of the economic base of the region. Whether this occurs would depend in part on the degree of excess capacity that may already exist. Potential impacts could occur in regions that cannot expand to accommodate new population growth if the demands of this growth are rapid or excessive.

Socioeconomic impacts from new workers needed to construct the SNS and for the operational phase are assessed. The study focuses on the potential effects of additional workers on housing availability and community services, including health care services, education, and public safety. Potential socioeconomic effects are assessed for the geographic region-of-influence (ROI) that would be most affected. The ROI includes those cities and counties where 90 percent or more of the current site workers reside.

The proposed project would require additional workers at any of the alternative site's ROI during construction and operations phases. In addition to jobs created directly by the proposed SNS, other job opportunities would be indirectly created within the ROI because of the increased spending of money. This money would be respent locally as jobs are created and business activity increases. The "multiplied" economic effect of this "respending" is estimated using the IMPLAN input-output model developed by the U.S. Forest Service, the Bureau of Land Management, and the University of Minnesota. Specifically, ROI estimates are made for employment, indirect business taxes, personal income, and total economic output. For each of these industry indicators, impacts are generated for direct effects, indirect effects, and induced effects. Direct effects are associated with the construction and operation of the facilities, but they also include the regional jobs necessary to support regional purchases of supplies and equipment. Indirect effects measure the increases in interindustry purchases (businesses buying more from other businesses), and induced effects reflect changes in household spending as regional income increases.

5.1.6.1 Environmental Justice Assessment

The environmental justice analysis focuses on potential disproportionately high and adverse human health or environmental effects from proposed alternatives to minority and low-income populations. The assessment is pursuant to Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, dated February 16, 1994, which directs federal agencies to incorporate environmental justice as part of their missions.

The approach used to address the potential for environmental justice impacts is based on data developed for the *Waste Management Programmatic EIS* (DOE 1997a). Minority and low-income populations residing within 50 miles (80 km) of DOE sites are identified and mapped. The 50-mi (80-km) radius around the site is consistent with the 50-mi (80-km) radius used to assess human health for all populations around the site. Data on geographic distribution of low-income and minority populations and prevailing wind conditions are used to assess whether toxic/hazardous pollutants and radiological releases from the proposed action would be emitted disproportionately in the direction of these populations.

For purposes of this analysis, a minority population consists of any census tract within 50 miles (80 km) of the SNS site with a minority population proportion greater than the national average of 24.4 percent. Minorities include persons classified by the U.S. Bureau of the Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, or other nonwhite, based on self-classification by the people according to the race with which they most closely identify. To avoid double-counting minority Hispanic persons (Hispanics can be of any race), only white Hispanics were included in the tabulation of racially based minorities. Nonwhite Hispanics had already been counted under their respective minority racial classification (for instance, Black, American Indian). A low-income population refers to U.S. Census Bureau data definitions of individuals living below the poverty line. For purposes of this analysis, a low-income population consists of any census tract within 50 miles (80 km) of the SNS site with a low-income population proportion greater than the national average of 13.1 percent.

5.1.7 CULTURAL RESOURCES

The assessment of potential impacts on cultural resources involves an evaluation of the projected effects of the proposed action, through the four siting alternatives, and the No-Action Alternative on prehistoric resources, historic resources, and traditional cultural properties (TCPs). A description of the baseline cultural resources environment at each of the four alternative sites for the proposed action is developed. Each description is based on the results of surveys and studies designed to identify cultural resources on and in the vicinity of these sites. The potential impacts are assessed by comparing the existing, baseline cultural resources environment to known, location-specific disturbances of this environment that would occur under the proposed action and the No-Action Alternative. Information obtained through consultations with the State Historic Preservation Officers (SHPOs) in Tennessee, New Mexico, Illinois, and New York is used to support the identification of cultural resources, their description, and the assessments of potential impacts on them.

5.1.7.1 Prehistoric Resources

Prehistoric resources in the United States consist of the significant physical remains of human activities that predate written records. They include, but are not limited to, sites containing stone tools, pottery, and the remains of ancient structures and hearths. To be identified as a prehistoric resource, such sites must be listed on, or eligible for listing on, the National Register of Historic Places (NRHP). The federal laws that protect such resources include the Archaeological Resources Protection Act and the National Historic Preservation Act (NHPA).

Archaeological surveys and studies are used to provide a baseline description of the prehistoric remains located on and in the vicinity of the four alternative SNS sites. Those remains that are listed on or eligible for listing on the NRHP are identified. These baseline descriptions of the existing prehistoric resources environment at each alternative site are provided in Sections 4.1.7.1, 4.2.7.1, 4.3.7.1, and 4.4.7.1.

The FEIS assesses how existing prehistoric resources on and in the vicinity of the four alternative SNS sites would be affected by implementation of the proposed action and the No-Action Alternative. This is done by closely comparing the locations of known prehistoric resources to the types and degrees of ground surface and soil disturbance that would occur from various aspects of the proposed action and the No-Action Alternative. As a result of such comparisons, a qualitative evaluation of potential damage or effects on resources is generated. Activities under the proposed action that would have the ability to remove surface features and disturb archaeological materials would typically include land clearing and excavation associated with construction of the SNS. Because the four alternative sites would be entirely cleared and excavated at an early point during construction of the SNS, any prehistoric resources on and adjacent to the four alternative sites would be susceptible to disturbance or destruction during this stage of the proposed action. Subsequent operation of the SNS would not be expected to affect any prehistoric resources that have already been destroyed by construction. Operation of the SNS would not involve the generation of intense ground vibrations or airborne shock waves that could affect prehistoric resources beyond the SNS site boundaries. The process of assessing potential effects includes the identification of measures to mitigate these effects.

If the proposed action, as implemented through the siting alternatives, or No-Action Alternative would have adverse effects on one or more prehistoric cultural resources, DOE would consult with the SHPO in the appropriate state to seek ways of avoiding or reducing these effects. As required by the federal regulations in 36 CFR 800.5(e)(1)(iii), the Advisory Council on Historic Preservation and other interested persons would also be afforded an opportunity to participate in these required consultations.

The identification of potential mitigation measures in the FEIS is based on the characteristics of the resources, their locations, and the nature of the anticipated effects. Such measures include the recovery of archaeological data through excavations, recording of architectural information, or the avoidance of effects by relocating a proposed site or activity. Typically, such measures must be taken prior to implementation of a proposed action or alternative.

If any artifacts or other remains indicative of a prehistoric cultural resource are inadvertently discovered during construction of the proposed SNS, construction activities on and in the vicinity of the discovery location would cease. DOE would then perform the above-described consultation with the SHPO. For purposes of compliance with Section 3(d) of the Native American Graves Protection and Repatriation Act, inadvertent discovery of human remains and funerary objects (associated and unassociated) would result in the cessation of construction activities, protection of the discovered items, notice of the discovery sent to the Indian tribes with the closest know cultural affiliation, and direction asked for treatment and disposition of the human remains or funerary objects. The 30-day delay period following official certification that notification of the accidental discovery has been received by the agency or tribe would be followed.

5.1.7.2 Historic Resources

Historic resources are the significant physical remains of human activities that post-date written records in the United States. They include, but are not limited to, historic archaeological sites, residential structures, commercial structures, and trails. To be identified as a historic resource, such remains must be listed on, or eligible for listing on, the NRHP. The federal laws that protect such resources include the Archaeological Resources Protection Act and the NHPA. In the United States, historic cultural resources date to the Historic Period, which spans the time from A.D. 1492 to the present day.

Archaeological site survey reports, historic site survey reports, and reports on historic site excavations are used to provide a baseline description of the historic remains located on and in the vicinity of the four alternative SNS sites. Those remains that are listed on or eligible for listing on the NRHP are identified. These descriptions of the historic cultural resources environment at each alternative site are provided in Sections 4.1.7.2, 4.2.7.2, 4.3.7.2, and 4.4.7.2.

The FEIS assesses how historic resources on and in the vicinity of the four alternative SNS sites would be affected by implementation of the proposed action and the No-Action Alternative. This is done by closely comparing the locations of known historic resources to the types and degrees of ground surface and soil disturbance that would occur at these locations as a result of the proposed action and the No-Action Alternative. From such comparisons, a qualitative evaluation of potential damage or effects on resources is generated. Activities under the proposed action that would have the ability to remove surface structures and disturb historic archaeological materials would typically include land clearing and excavation associated with construction of the SNS. Because the four alternative sites would be entirely cleared and excavated at an early point during construction of the SNS, any historic resources on and adjacent to the four alternative sites would be susceptible to disturbance or destruction during this stage of the proposed action. Subsequent operation of the SNS would not be expected to affect any historic resources that have already been destroyed by construction. Operation of the SNS would not involve the generation of ground vibrations or airborne shock waves that could affect historic resources beyond the SNS site boundaries.

If the proposed action, as implemented through the siting alternatives, or No-Action Alternative would have adverse effects on one or more historic cultural resources, DOE would consult with the SHPO in the appropriate state to seek ways of avoiding or reducing these effects. As required by the federal regulations in 36 CFR 800.5(e)(1)(iii), the Advisory Council on Historic Preservation and other interested persons would also be afforded an opportunity to participate in these required consultations.

The identification of potential mitigation measures in the FEIS is based on the characteristics of the resources, their locations, and the nature of the anticipated effects. Such measures include the recovery of archaeological data through excavations, recording of information on historic structures and features, or the avoidance of effects by relocating a proposed site or activity. Typically, such measures must be taken prior to implementation of a proposed action or alternative.

The inadvertent discovery of historic resources during construction of the proposed SNS would be handled in the manner described in Section 5.1.7.1.

5.1.7.3 Traditional Cultural Properties

A TCP is a significant place or object associated with the historical and cultural practices or beliefs of a living community. It is rooted in the community's history and is important for maintaining the continuing cultural identity of the community. A TCP may include a prehistoric or historic archaeological site, natural resource, traditional use area, shrine, sacred place, trail, spring, river, traditional hunting area, cemetery or burial site, or rock art. In addition, it may include a rural community or urban neighborhood with a unique cultural tradition and identity. The term is not limited to ethnic minority groups. All Americans have properties to which they ascribe traditional cultural value.

TCPs are protected under the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act. These laws and their implementing regulations establish procedures for the identification and protection of TCPs. Sites that are sacred to

American Indians and access to these sites by Indian religious practitioners are protected under Executive Order 13007. (Refer to Section 6.1.8).

Existing reports of consultations with Native American tribal groups and Hispanic groups are used, when possible, to identify and locate TCPs on and in the vicinity of the four alternative SNS sites. If the site at LANL is selected for construction of the SNS, additional consultations with tribal and Hispanic groups are planned to identify other specific TCPs on the SNS site. Descriptions of the TCP environment at each alternative site are provided in Sections 4.1.7.3, 4.2.7.3, 4.3.7.3, and 4.4.7.3.

The same basic methodological approach used to assess the effects of the proposed action and No-Action Alternative on prehistoric and historic resources is used to assess their effects on TCPs. DOE plans to develop and implement mitigation measures in close consultation with those tribal and Hispanic groups that ascribe traditional cultural value to the affected TCPs.

5.1.8 LAND USE

The land use analysis assesses the potential effects construction and operation of the SNS would have on land use patterns on and in the vicinity of the four alternative sites for the proposed action. In addition, the potential effects of the No-Action Alternative on land use are also assessed.

Descriptions of the past, current, and planned future land use environments of the four alternative SNS sites are developed using a variety of information sources. These include data calls, facility site development plans, land use plans, reports on stakeholder land use recommendations to DOE, technical reports, and aerial photographs. These descriptions of the affected land use environment provide a baseline framework for assessing the effects of the proposed action on land use at the four alternative SNS sites. The descriptions are presented in Sections 4.1.8, 4.2.8, 4.3.8, and 4.4.8.

A qualitative approach is used to assess the extent and magnitude of potential effects on land use patterns that would result from implementing the proposed action on each alternative site and from implementing the No-Action Alternative. This is done by comparing current land uses and land use plans to anticipated changes in land use that would occur as a result of implementing the proposed action and the No-Action Alternative. The land use analysis assesses the following: effects on land use outside laboratory boundaries and throughout most laboratory land; effects on undeveloped land; effects on the current use of SNS site land; effects on the use of laboratory land for research purposes; effects involving the zoning of SNS site land for future use; effects on the future use of SNS site land and land adjacent to it; and effects on the use of land for parks, nature preserves, and recreation.

Potential effects on visual resources are assessed qualitatively using the degree of visual contrast between activities under the proposed action and No-Action Alternatives and the existing landscape character as seen from viewpoints accessible to the public. The sensitivity levels of viewpoints and visibility of the SNS sites to the public are taken into consideration in the assessments.

5.1.9 HUMAN HEALTH

The assessment of impacts to workers and the public for radiological and toxic material releases considers both normal operations and facility accident conditions. Doses and consequences are calculated in a parallel manner for all alternatives to provide quantifiable indicators for comparison between the alternatives. The steps in evaluating quantifiable consequences follows:

- Identify and quantify emissions (source terms);
- Identify and select human exposure pathways;
- Analyze transport of contaminants through each exposure pathway;
- Calculate dose to individual, group, or population;
- Quantify consequences in terms of excess latent cancer fatalities (LCFs); and
- Discuss and evaluate consequences.

The emission of radioactive and toxic materials and the human exposure pathways are generic for the SNS and are independent of the specific proposed site. The analysis of material transport from the SNS to the potentially exposed individual(s) and the calculation of resulting concentrations and doses use site-dependent factors such as recent meteorology, actual population distributions, and the proposed facility location with respect to the site boundary. Site-specific doses are then converted to the projected number of incremental or excess fatal cancers using dose-to-risk conversion factors (DOE 1993b). A discussion of the methods and assumptions used in each of these steps is provided below. Additional details of emission identification and calculations of atmospheric dispersion and doses are provided in Appendix G.

5.1.9.1 Radioactive Emissions

Radioactivity would not be discharged from the proposed SNS to surface water under normal conditions of operation. Liquid low-level waste (LLLW) and process waste would be collected and transported by tanker truck to existing waste processing facilities. Radioactive emissions to the atmosphere from the proposed SNS would consist of releases from two stacks—the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack. The locations of these stacks are shown in Figure 3.2.1.5-1.

Annual emissions from these systems are summarized in Table 3.2.3.5-1 for power levels of both 1 MW and 4 MW. A detailed list of radionuclide emissions used for dose calculations is provided in Table F-1 of Appendix G. Assumptions on facility design for upgrade from 1 MW to 4 MW result in a linear scaling of off-gases from the cooling system and the target. Off-gases from the beam stops and exhausts from the various tunnels through the Tunnel Confinement Exhaust do not scale linearly due to specifics of the proposed upgrade design.

5.1.9.2 Exposure Pathways

Routine airborne emissions of radionuclides result in internal exposures of on-site workers by way of inhalation and external exposures via immersion in the plume of released radionuclides and from radionuclides deposited on the ground surface. The off-site public could be exposed through these same pathways as the workers and could receive additional internal exposures by way of a series of ingestion pathways initiated by the deposition of radionuclides on the ground surface and leafy surfaces in pasture lands and gardens. These radionuclides are then taken up directly through ingestion of contaminated vegetation or indirectly through ingestion of meat or dairy products from animals that had ingested the vegetation.

Many of the mercury radionuclides produced in the target and emitted from the Target Building Exhaust Stack decay through a series of radioactive progeny called a decay chain. The half-lives of the various members of a decay chain cause individual members of the chain to be more or less important in the various exposure pathways. Radionuclides with a short half-life are a more significant hazard for inhalation, an exposure that occurs within minutes or hours of release; but a radionuclide with a long half-life could be important for ingestion, which would occur within days to months following the release.

5.1.9.3 Calculation of Atmospheric Dispersion and Doses

A number of computer codes are available that can account for dispersion, deposition, and radioactive decay of radionuclides released to the environment. Codes such as GENII and MACCS are comprehensive codes that model atmospheric dispersion and calculate doses in a single evaluation. CAP88-PC is a widely used code that performs such calculations for continuous releases such as SNS normal emissions. However, these codes could not be used in this analysis because of the unique radionuclide products activated in the mercury target of the SNS. The activated mercury products and members of the associated decay chains were not included in the databases of these codes, their decay and in-growth during dispersion could not be modeled, conversion factors from environmental concentration to individual dose were not available, or the source code did not enable additional radionuclides to be added to the analysis.

For normal conditions of continuous low-magnitude emissions, a set of Microsoft Excel 97 spreadsheet and Visual Basic macros were developed to implement the methodology used in CAP88-PC and allow the evaluation of the unique SNS radionuclides. This methodology is described in the code user guide (EPA 402-B-92-001 – EPA 1992). The documentation for AIRDOS-EPA (Moore 1979), a mainframe predecessor of CAP88-PC, contains additional detail and a source code listing. Details of the implementation of the methodology are discussed in Appendix G.

This methodology uses a Gaussian plume model to calculate sector-averaged depleted ground-level concentrations in air and ground deposition rates of radionuclides. The depletion mechanisms considered are radioactive decay and ingrowth, precipitation scavenging, and dry deposition. Buildup of radionuclides deposited on the ground and on plant surfaces are also considered. Concentrations in vegetation, beef, and milk consumed by humans are calculated using soil-to-plant, animal feed-to-milk, and animal feed-to-beef transfer factors. Intake of radionuclides by humans is calculated based on agricultural production data for the appropriate state and consumption rates of leafy vegetables, produce, milk, and beef.

For short-term releases occurring in accidents, atmospheric dispersion calculations were performed using PAVAN, a public-domain compiled program used by the NRC to calculate ground-level normalized atmospheric dispersion factors for short-term releases at ground level and at elevation (PNL 1982). PAVAN uses site-specific annual wind patterns to determine short-term or averaged dispersion in 22.5^{o} sectors surrounding the site.

The computer spreadsheets developed to estimate dose from airborne emissions incorporated the atmospheric dispersion from the codes, the duration and source terms for the individual release scenario (normal operations or accident), site-specific data on population distribution of on-site workers and off-site public, and radionuclide-specific dose conversion factors (DCFs) to convert environmental concentration to individual dose. Population effects are calculated using actual population distributions within 80 km (50 mi) of each release site. These spreadsheets perform rigorous decay calculations for all radionuclide chains for the proposed SNS and calculate the dose to workers and the public from inhalation and immersion. The analysis also includes the estimated contribution of dose from radionuclides deposited on the ground and from ingestion as discussed in Appendix G (Section F.5.3).

Most radiological dose assessments use DCFs published by the U.S. EPA in Federal Guidance Report No. 12 (Eckerman and Ryman 1993). However, these published and accepted DCFs do not include data for all of the mercury and iodine radionuclides or their decay products that are anticipated in SNS emissions. At DOE request, staff at ORNL, who produced the published data, developed DCFs for inhalation, ingestion, immersion, and ground plane exposure to isotopes of mercury, iodine, and their decay products (Eckerman 1998a, Eckerman 1998b). The discussion in Appendix G provides more detail of, and the basis for, the use of the various DCFs in this dose calculation.

5.1.9.4 Quantification of Radiological Consequences

DOE uses the linear dose response, no threshold model to compute the potential risk of radiological exposures for each alternative considered in an EIS (DOE 1993b). This model estimates excess LCFs using dose-to-risk conversion factors recommended by the International Commission on Radiation Protection (ICRP) (ICRP 1991). For low-dose, low-dose rate exposures (< 20 rad, < 10 rad/hr), ICRP recommends factors of 0.0004 LCF per person-rem for workers and 0.0005 LCF per person-rem for the public. The higher risk factor for the public reflects the presence of children in the public who are not present in the workforce.

To estimate the total potential risk to the population within 50 miles of the SNS facility from the radioactive emissions from the facility over its 40-year life span, the annual population dose is multiplied by the operating life of the facility and the dose-to-risk conversion factor of 0.0005 LCF per person-rem.

This method of quantifying effects is a conservative assumption of biological response to radiation dose. To compare potential impacts, dose-to-risk conversion factors are applied as if any radiation exposure, no matter how small, involves some potential risk. While the human body has the ability to repair cell damage caused by radiation and other agents, the present state of scientific knowledge does not allow the threshold at which radiation dose would lead to the development of a fatal cancer to be determined with any certainty. Accordingly, DOE conservative estimates provide an assurance that the potential effects will not be underestimated, while accepting that assumptions may lead to an overestimate of potential consequences.

5.1.9.5 Toxic Material Emissions and Consequences

The only toxic material that would be emitted from the proposed SNS during normal operations is elemental mercury vapor. Lead would be used for radiation shielding in the target areas and other areas of the proposed SNS, but it is not volatile at the temperatures to which it would be subjected. Elemental mercury vapor would be present in the gases released from the Target Building Exhaust Stack from two sources: off-gassing from the target and in air from the target cell ventilation system due to evaporation of small droplets assumed to be adhering to the cell drain surfaces. Exposures of individual workers to mercury vapors are evaluated by comparing calculated concentrations to limits promulgated by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH). For continuous or unlimited duration exposure of the general public, the EPA has established a Reference Concentration (RfC) intended to prevent the occurrence of observable detrimental effects.

5.1.9.6 Accident Conditions

During operation of the proposed SNS, it is possible that equipment failures, human errors, or natural phenomena would result in the release of radiation, radioactive materials, or toxic materials. Such releases could have potential adverse effects on the health of workers and the public. The significance of these potential effects is evaluated in terms of probability that a given accidental release would occur and the consequences of the release if it does occur.

5.1.9.6.1 Accident Scenarios

DOE has analyzed a wide range of potential hazards associated with operation of the proposed SNS and, based on this analysis, has selected bounding accidents. For each of the bounding accidents, the frequency of occurrence and source terms has been estimated. A source term specifies the quantity or activity of material released and duration of the release. The accident analysis is included as Appendix C of this FEIS.

Accident frequencies are described using the terms “anticipated,” “unlikely,” “extremely unlikely,” and “beyond extremely unlikely.” These terms and their corresponding ranges of frequencies of occurrence are defined in Table 5.1.9.6.1-1. Some accidents are described as “beyond design basis.” Such accidents usually have frequencies of occurrence less than 1×10^{-6}/yr. Table G-2 (refer to Appendix G), summarizes information about the accidents described in detail in Appendix C.

5.1.9.6.2 Direct Radiation in Accidents

Accidents involving exposure to direct radiation are not specifically addressed in Appendix C. Very high levels of radiation would exist in the linac tunnel, ring tunnel(s), high-energy beam transport tunnels, and target areas when the particle beam is present, but they would rapidly decrease immediately after the beam is shut off. A combination of administrative controls, written procedures and training, and design features would be used to prevent exposures to

Table 5.1.9.6.1-1 Accident frequency categories

Category	Description	Annual Frequency of Occurrence (yr^{-1})
Anticipated	May occur several times during the lifetime of the facility	1 to 10^{-2}
Unlikely	Not anticipated to occur at some time during the lifetime of the facility (includes accidents initiated by Uniform Building Code-level earthquake, 100-year floods, maximum wind gust, etc.)	10^{-2} to 10^{-4}
Extremely Unlikely	Probably will not occur during the lifetime of the facility (includes design basis accidents)	10^{-4} to 10^{-6}
Beyond Extremely Unlikely	Not credible during the lifetime of the facility (beyond design basis accidents)	$<10^{-6}$

high levels of direct radiation in accordance with the requirements of 10 CFR 835 Subpart F, "Entry Control Program." DOE's Shielding Design Policy for the proposed SNS is such that for the worst-case design-basis accident, the dose to the maximum exposed individual in an uncontrolled area would be limited to 1 rem and for a worker in a controlled area would be limited to 25 rem.

5.1.9.6.3 Radioactive Materials Accidents

The consequences of accidents resulting in the release of radioactive materials have been evaluated using the same methods and site-specific data used to evaluate the effects of normal operations. These methods and data are discussed in detail in Appendix G. Exposures that would result from the release of radioactive materials during credible and beyond design-basis accidents at the proposed SNS are low-dose, and low-dose rate events. Accordingly, the same dose-to-risk conversion factors of 0.0005 LCF per person-rem for exposures of the public and 0.0004 LCF per person-rem for workers used to estimate effects of normal operations have been used to estimate accident consequences.

5.1.9.7 Consequence Evaluation

For each location, doses to the maximum exposed individual, both the uninvolved worker and the member of the public, and the population dose are estimated using site-specific population distributions. Doses are converted to consequences expressed as excess LCFs, using factors recommended by the ICRP.

5.1.9.7.1 Releases in Routine Operations

The proposed SNS would be operated so that radiation dose to workers and the public from radiation and radioactive emissions in routine operations would not exceed applicable regulatory limits. The Shielding Design Policy for the Proposed SNS (ORNL 1997a) was developed to ensure compliance with the requirements of Title 10 CFR Part 835, *Occupational Radiation Protection*, and DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. Further, adherence to the as low as reasonably achievable (ALARA) program requirements will ensure that operations are conducted in a manner to maintain the exposures far below these regulatory limits. Consequences to the uninvolved on-site worker and to the off-site population resulting from routine emissions of radioactivity and mercury have been quantified as discussed above. The numerical results are presented in individual sections addressing each alternative site.

5.1.9.7.2 Accidental Releases

The evaluation of accidents is based on the potential exposures of uninvolved workers and the public to airborne radioactivity during the period of uncontrolled release. These exposures are limited to dose from inhalation and immersion. This FEIS presents an analysis of risk based on a conceptual design, one of the earliest stages of the design process. As a result, the mitigating effects of many systems and design features that would reduce the likelihood and/or the consequences of postulated accidents have not been incorporated or have been assumed to function at reduced efficiency.

In the quantification of consequences, an LCF estimate of 1.0 or greater does not mean that a fatality will necessarily occur. Instead, the calculation of estimated LCFs provides a numerical value to compare whether impacts to human health could be greater for one alternative than for another. The magnitude of LCFs are calculated based on the assumption that a release has occurred; the probability that the LCFs will appear depends on the probability of the radionuclide release. At this stage of design, releases during normal operations and the probability of an accident occurring cannot be separately evaluated by alternative. Probabilities or accidental frequencies are provided in Appendix C.

5.1.10 SUPPORT FACILITIES AND INFRASTRUCTURE

The following sections present the methods used to evaluate the potential effects on transportation and utilities for the proposed construction and operation of the SNS.

5.1.10.1 Transportation

The transportation impact analysis examines the predicted increases in traffic on roads in proximity to the alternative SNS sites versus the baseline average daily traffic those same roads currently handle. The primary determinants of transportation effects are changes in traffic at peak use times (rush hr) that diminish the level of service (LOS) for those traveling on the road. The analysis of traffic effects also includes accounting for the non-passenger vehicles (i.e., trucks, heavy equipment) associated with both construction and operational phases at each of the four proposed SNS sites.

Based on the design of the proposed action (as described in Section 3.2), assumptions are made regarding the number of vehicles that would travel to the proposed SNS location for the construction and operational phases. Specific-ally, site employees are assumed to drive a maximum of 466 passenger vehicles to the site during peak year construction (2002) at each of the four alternative sites. Construction vehicles account for an additional seven trucks per workday of the 5-year construction period. Service vehicles are assumed to add an additional three trucks per day during both the construction and operational phases of the proposed SNS. Three hundred and two passenger vehicles are assumed to support SNS operations at its maximum (4 MW) operating power. Using the maximum construction-year number of employees and the maximum operations number of employees for the analysis provides the most conservative analysis (worst case) of the potential effects on transportation.

Baseline average daily traffic data are compiled from site-specific traffic analyses or from recent local traffic counts. The predicted change in traffic is based on the number of employees currently traveling to the respective sites, added to the incremental increase in traffic attributable to the SNS construction and operational activities, minus a factor for carpooling. This increase in traffic volume to the site, added to the total number of vehicles currently utilizing the same access roads, provides the basis for analyzing the changes in service.

5.1.10.2 Utilities

Basic utility services are necessary for construction and operation of the proposed SNS and are evaluated to examine the accessibility and available capacity to service the SNS at each of the locations considered. The design requirements for utility services (electrical, steam, natural gas, water, and sanitary waste treatment) would be the same at each of the four sites and provide a consistent basis of comparison for the site-specific analysis. The site-specific information to support the utilities analysis (accessibility and capacity) is developed by phone interviews with individuals at each of the alternative sites being considered. This information is then used to assess the effects from providing the required services to the proposed SNS. Where possible, these services are assumed to extend from the points where existing sources of sufficient quantity make their nearest approaches to the SNS site.

5.1.11 WASTE MANAGEMENT

The analysis for waste management evaluates impacts of the proposed action on the existing and projected waste management activities at the alternative sites against the No-Action Alternative at that site. The assessment addresses the waste types and waste capacities from the various waste management facilities at each site and compares them with the No-Action Alternative.

The FEIS assesses the environmental effects associated with waste management for construction and operation of the proposed action. The following categories of waste are analyzed: hazardous, low-level, mixed, and sanitary. Design capacity, site waste projections, SNS waste operations projections, and remaining site capacity data are reviewed for all waste facilities at each of the four alternative sites. Based upon this information, the potential effects the proposed action would have on the existing waste management facilities, and hence the overall site, are assessed. Effects are assessed if the current waste management facilities at each alternative site are not adequate for accommodating the waste that would be generated by the proposed SNS. The waste management information provided for this assessment is based on figures and estimates obtained from current waste management documentation and information provided by waste management subject matter experts from each site.

5.2 OAK RIDGE NATIONAL LABORATORY

This section describes the potential environmental impacts or changes that would be expected to occur at ORNL if the proposed action were to be implemented. Included in the discussion of this section are the impacts to the physical environment; the ecological and biological resources; the existing social and demographic environment; the cultural, land, and infrastructure resources; and public/worker health.

5.2.1 GEOLOGY AND SOILS

Effects on the geology and soils from construction and operation of the proposed SNS on the proposed Chestnut Ridge site at DOE's Oak Ridge Reservation (ORR) are described in the following sections.

5.2.1.1 Site Stability

Survey data accumulated to date indicate that no effects would occur from the construction or operation of the proposed SNS at the Chestnut Ridge site. Results from a preliminary geotechnical investigation (LAW 1997) have not encountered soil stability problems at the site. Soil borings have determined that depth to bedrock is highly variable and in excess of 100 ft (30 m) deep.

Karst voids in the bedrock may occur at depth on the proposed SNS site, and anthropogenic factors such as construction of the SNS can increase the rate of sinkhole formation. Site characterization studies would discover active sinkholes. Therefore, if the Record of Decision selects the proposed action, DOE would complete an optimization study for the selected siting alternative. This study, which would include detailed boring and geophysical surveys, would determine the optimal layout of facilities on the selected site and would include the avoidance of sinkholes.

It should also be noted that cost-effective engineering methods are available to mitigate the potential effects of karst formation. The conceptual design proposes to construct the SNS foundation with a floating slab design supported by the soil column. Foundation designs would account for specific loading factors for each component of the facility to achieve acceptable levels of differential settling between accelerator components. If the final design requires heavily loaded structures that are extremely sensitive to differential settlement, mitigation measures may include the removal of soil and replacement with a less compressible medium (for example, flowable fill or crushed stone). In extreme cases, foundation supports could be installed by driving piles or drilling piers to solid rock at depth. No effects are anticipated from site stability.

5.2.1.2 Seismic Risk

Components of the proposed SNS would be designed and constructed to withstand the magnitude of earthquake shocks that are considered likely to occur in this area. In 1989, DOE issued Order 6430.1A to be used for seismic design of new facilities and the evaluation of existing facilities. Because of the many uncertainties about seismicity of the central and eastern United States, new efforts to evaluate seismicity were undertaken by the Electric Power Research Institute and Lawrence Livermore National Laboratory (sponsored by the NRC). Based on those facilities' studies, additional studies by Lockheed Martin Energy Systems (LMES), specifications required under new DOE orders, and other advances in the art of evaluating seismic hazards, revised assessments to support the design of new facilities and the evaluation of existing facilities were conducted (Beavers 1995). This assessment resulted in new seismic criteria for DOE-Oak Ridge Operations (DOE-ORO). Table 5.2.1.2-1 presents estimated peak ground acceleration (PGA) at locations with greater than 30 ft (10 m) of soil cover (as would be the case with the proposed SNS at Chestnut Ridge). Buildings and components of the proposed SNS would be designed to withstand corresponding earthquake levels without sustaining serious damage. As such, predictable seismicity for the proposed Chestnut Ridge site would have no effect on the construction, operation, or retirement of the proposed SNS.

5.2.1.3 Soils

Excavations required for construction of the proposed SNS would disturb the native soils. Excavated soils would be stockpiled according to soil type and horizon. If the excavated soils possess the proper characteristics, they would be used to construct the shielding berm. Otherwise, the soils would be placed in the spoils area (refer to Section 3.2.5.2). Topsoil removed during excavation would be used for grading and landscaping of the site at the finish of construction.

Construction of the SNS would require grading of the site and removal of vegetative cover. As a result, the potential exists for soil erosion and stream siltation especially during periodic storm events. Best management practices would be followed to minimize the impacts of erosion during construction activities. Section 3.2.2.3, Site Preparation, discusses the elements (retention basin, silt fences, temporary storm water drainages, etc.) that would follow an erosion control plan to prevent erosion and siltation of White Oak Creek.

Operation of the proposed SNS would affect soils used for shielding surrounding the linac tunnel. The proposed SNS would produce particles that would diffuse outward from the center of the beam within the linac tunnel and would interact with any physical matter, producing a series of nuclear cascades. This reaction is termed neutron activation, whereby the soils would become radioactive. Analyses show that activation products would be concentrated toward the last 65.6 ft (20 m) of the linac tunnel nearest the target structure and that 99.9 percent of the radionuclides in the activation zone would be contained within the first 4 m of soil surrounding the tunnel. The radionuclides created within the soil and in pore waters within the matrix of the soil would then be subject to leaching and transport via groundwater movement. An assessment of radionuclide activities or concentrations at a boundary 32.8 ft (10 m) from the tunnel was made for a 10-year period after closure. It is estimated that if the activation were spread uniformly over the full length of the linac tunnel, 309,000 Ci would be contained within the soil (see Section 5.2.2.3). The primary effects due to activation of the soil would be its effect on groundwater (refer to Section 5.2.2.3 for groundwater impacts) and the mitigation of a radioactive source term to close the facility at

Neutron Activation is the process of creating unstable radioisotopes or nuclides by the adsorption of neutrons into the nucleus of an atom.

Table 5.2.1.2-1. Seismic design criteria for ORR.

Return Period (years)	Mean PGA[a] New Site-Specific Criteria [depth of soil >30 ft (10 m)] Horizontal	Vertical
0	0.00	0.00
500	0.15	0.10
1,000	0.20	0.13
2,000	0.30	0.20
10,000	NA	NA

[a] Beavers 1995.
NA - Not available.

the end of its operational life. An evaluation of the activation products generated and transported in the subsurface was conducted to determine the effect on the environment (Dole 1998).

Multiple conservative assumptions were made in the study to ensure the protection of the environment. These assumptions were employed for the site-specific study at ORNL but would apply to the alternative sites in the qualitative comparison between site-alternatives. Several of the key conservative assumptions would overstate the potential for migration of the radionuclides:

- The facility operates continuously for 30 years—overestimating significant periods of time when the SNS linac is not operational and radionuclides are not generated.
- The entire soil volume surrounding the tunnel is subjected to the same level of neutron activation as the high-energy end of the linac—resulting in an overestimation by several factors in the volume of the activation products generated.
- Activation products remain within the berm and do not begin to move until the end of the facility's life, and all of the radionuclides are immediately available for diffusion and hydraulic transport—thereby overestimating the maximum starting concentrations and transport potential of radionuclides.
- Saturated flow continuously exists around the outer surface of the berm to carry contaminants to the water table—even though the linac tunnel will be located in the unsaturated soil horizon.
- The use of laboratory-measured diffusion coefficients to simulate real-world conditions provides a high estimate of diffusion and transport of radionuclides.

Even using very conservative assumptions, it is concluded that radioactive decay would eliminate any significant effects to human or ecological receptors because of the slow movement by the groundwater.

No prime or unique farmlands are present on or in the vicinity of the proposed SNS site at ORNL. As a result, the proposed action would have no effects on prime or unique farmlands.

5.2.2 WATER RESOURCES

Effects on the water resources from the construction and operation of the proposed SNS located on the proposed Chestnut Ridge site at DOE's ORR are described in the following sections.

5.2.2.1 Surface Water

The effects on surface water resources from operation of the proposed SNS are discussed in this section. Best management practices would be employed to minimize any effects on surface water due to erosion and siltation during construction (see Section 5.2.1.3).

5.2.2.1.1 Water Supply

Melton Hill Lake is the primary water source for the City of Oak Ridge and DOE facilities. Potable water supplies would be delivered to the proposed SNS site by an existing 24-in. (61-cm) line from the Oak Ridge Water Plant. Currently, there is no estimate of the amount of water required for construction. However, it is expected that construction water requirements would be negligible compared to the available supply. Demands ranging from 800 to 1,600 gpm (3,028 to 6,057 lpm) would be required to support operations at the proposed SNS facility, which may be upgraded throughout its operational life from 1 MW to 4 MW. These demands could be met by the existing capacity of the system.

5.2.2.1.2 Discharge

Of the total water demands, conventional cooling tower usage would require 700 gpm (2,650 lpm) for a 4-MW facility. Roughly one-half of this volume [350 gpm (1,325 lpm)] would be needed to replenish water lost through evaporation, and one-half [350 gpm (1,325 lpm)] would be needed for make-up water to replace blowdown water discharges. Cooling tower usage is estimated at about 500 gpm (1,893 lpm) for a 2-MW facility. A continuous discharge or blowdown would be released into a retention basin on the proposed SNS site. At the conceptual design stage, the size of the retention basin required is estimated at approximately 2 acres (0.81 ha). This basin would be designed to allow sufficient residence time for the discharge to cool to ambient temperatures. If necessary, active cooling systems such as recirculating fountains may be employed. From the retention pond, the discharge would be piped to below the White Oak Creek weir located at the base of Chestnut Ridge before release in the White Oak Creek drainage system.

Base flow at the White Oak Creek weir has been gauged at 0.15 to 0.25 mgpd (0.57 to 0.95 million lpd) during the dry season and at 0.75 to 1.0 mgpd (2.84 to 3.8 million lpd) during the wet season (refer to Section 4.1.2.1). The addition of the proposed SNS discharge [0.36 to 0.50 mgpd (1.4 to 1.9 million lpd)] to White Oak Creek would increase the flow rate by roughly 50 percent in the wet season and by a factor of two or more during the dry season. Effects resulting from a 50 to 200 percent increase in flow would include increased stream velocity, channel size, erosion and sediment transport (at least until an equilibrium is reached), and possibly water parameter changes from ambient conditions.

Polyphosphonates for antiscaling and ozone as a biocide would be used in the cooling towers as is the common practice at other ORNL cooling towers. Discharge from the towers would be regulated to contain about four times the dissolved solids content of potable water (i.e., 1,000 to 1,200 mmhos conductivity).

Discharge by the proposed SNS into White Oak Creek would provide a net increase to the water budget of the Bethel Valley and Melton Valley watersheds. As such, it is possible that discharge by White Oak Creek into White Oak Lake could increase, which in turn might lead to an increase in flow over White Oak Dam. The discharges from the SNS would not be a source of additional radionuclides to White Oak Creek. Because White Oak Lake acts as a reservoir for radionuclides in suspension and in solution, an increase of flow over the dam could effect the release of radionuclides. Assuming no loss by evapotranspiration and no infiltration or recharge to the intermediate and deep groundwater regimes, the maximum estimated discharge (at full loading for 4 MW) from the proposed SNS would increase the White Oak Dam flow by 2 to 4 percent during the wet weather season and by 10 to 15 percent during the dry weather season (Figure 5.2.2.1.2-1). Actual losses by infiltration and evapotranspiration would reduce the contribution by the proposed SNS over White Oak Dam by well over 50 percent of the maximum. In fact, the measure of any real contribution to actual flow over White Oak Dam would be lost in the noise of monthly variance in precipitation. Accordingly, the effect of the proposed SNS on radionuclide releases from ORNL is considered minimal.

5.2.2.2 Flood Potential and Floodplain Activities

The proposed SNS at ORNL does not lie within a floodplain or designated flood fringe area; therefore, flood potential of the site is negligible. Seasonal storm events may cause limited flooding along Chestnut Ridge and portions of the proposed site when man-made storm drains and natural drainage channels exceed capacity. The effect would be localized and temporary.

5.2.2.3 Groundwater

The effects of proposed SNS construction and operations on groundwater are discussed in this section.

5.2.2.3.1 Resources

Construction and operation of the proposed SNS would have minimal to no effect on the intermediate and deep groundwater systems at the proposed Chestnut Ridge site, and no groundwater resources would be utilized by SNS construction or operations. Depth to

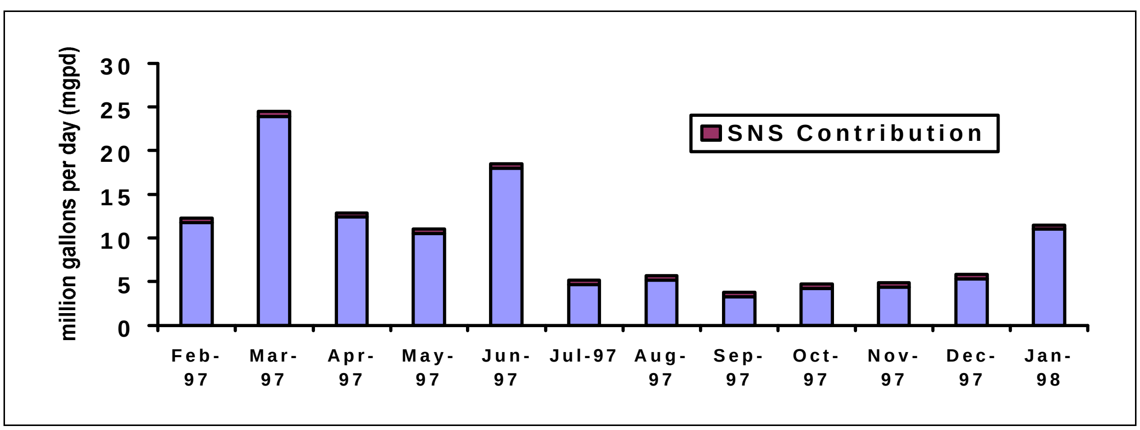

Figure 5.2.2.1.2-1. Proposed SNS contribution to flow over White Oak Dam.

groundwater observed during preliminary site characterization activities may be as deep as 100 ft (30.5 m), and the maximum planned excavation should not intersect the water table. If conduit flow of groundwater within the bedrock exists beneath Chestnut Ridge, the surface excavations required to construct the facility would not affect the flow capacity or yield from these zones. Also, the limited footprint of the proposed SNS would not materially affect the recharge by infiltration to the shallow groundwater zone or to the Knox aquifer underneath Chestnut Ridge. There could be increased recharge to the groundwater system if the proposed SNS retention pond is built above a karst system. <u>However, the final location of the retention basin has not been determined yet. If the ORNL site is selected in the ROD for construction of the SNS, the Chestnut Ridge site will undergo an extensive characterization to provide detailed information necessary for Title I and Title II (preliminary and detailed) design. A site optimization study would also be completed to identify the optimal layout of the SNS facilities, including the retention basin. If problematic karst features are discovered, the optimal site layout may avoid these features. If the retention basin cannot be placed in an area that avoids karst formation, the appropriate engineering solutions, such as grouting, would be implemented.</u>

5.2.2.3.2 Contamination

In addition to determining the types and quantities of radionuclides generated in the soil berm, an evaluation of transport of these contaminants under natural conditions was conducted. Figure 5.2.2.3.2-1 depicts the hydrologic cross section used to calculate the infiltration of precipitation from above and the flow of groundwater below the proposed site.

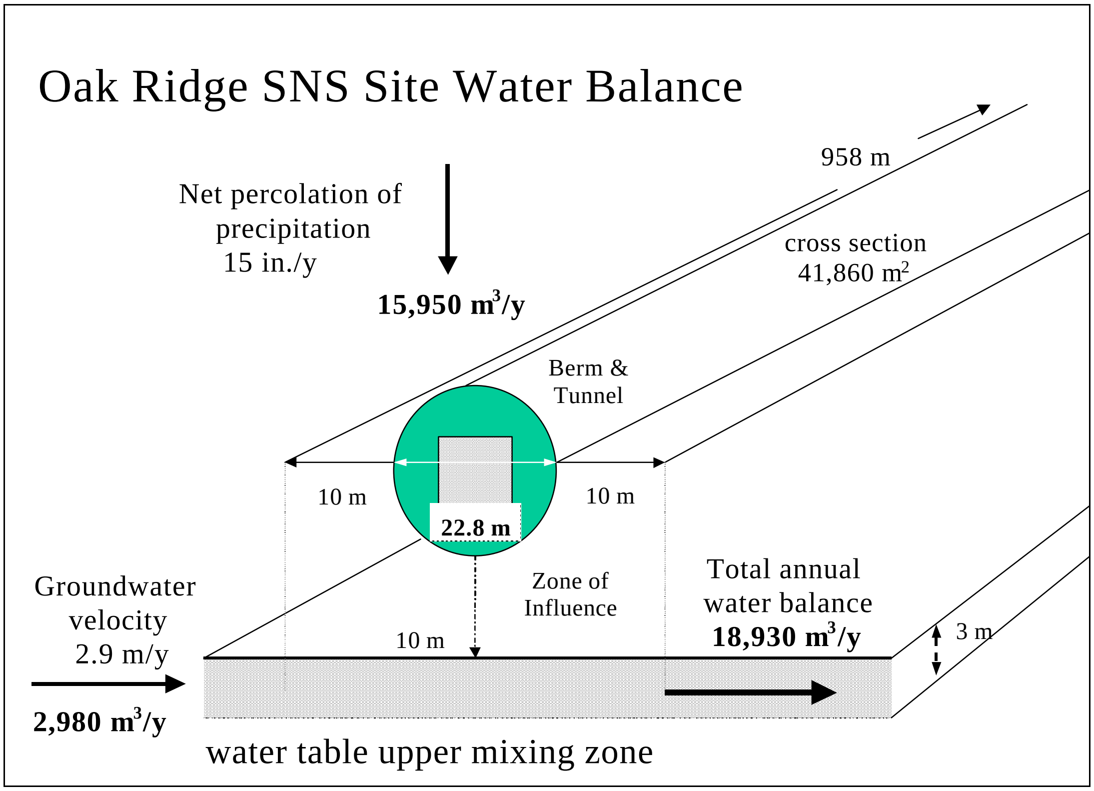

Figure 5.2.2.3.2-1. Hydrologic cross section of the proposed SNS site at ORNL.

Assuming an arbitrary 32.8-ft (10-m) compliance boundary beyond the 72-ft (22-m) diameter of the berm, the cross section of the 3,143-ft (958-m) long proposed SNS tunnel system has an effective area of 450,577 ft^2 (41,860 m^2). With 15 in. (38.1 cm) of annual recharge at the ORNL site, a volume of 563,274 ft^3 (15,950 m^3) per year would infiltrate through the berm into the groundwater. With a 9.8-ft (3-m) thick mixing zone and groundwater velocity under this site at 2.9 m/yr, the annual horizontal contribution of groundwater under the proposed SNS tunnels is only 105,238 ft^3 (2,980 m^3). This brings the total annual water balance under the proposed SNS facility and its 32.8-ft (10-m) zones of influence to an annual turnover of 668,513 ft^3 (18,930 m^3) per year. The flow-through rate was combined with the calculation of migration rates of contaminants to the outer berm surface and was used to estimate concentrations of radionuclides in the groundwater. Using an assumed saturated hydraulic conductivity for the vadose zone of 1 m/yr (a conservative assumption compared to measurements approaching 0.2 m/yr), water carrying contaminants from the berm's surface would reach the 32.8-ft (10-m) boundary zone in only 10 years. During that time, a number of radionuclides in transport would decline in activity due to half-life decay. Table 5.2.2.3.2-1 displays the estimate of isotope activities at the 32.8-ft (10-m) boundary 10 years after closure of the facility (Dole 1998). The NRC limits for uncontrolled releases are included on this table as a benchmark for comparison.

Table 5.2.2.3.2-1. Estimates of radionuclide concentrations in soils and water surrounding the proposed SNS.

Isotope	Half-Life (years)	Total Curies in berm at 0 - 4 m Over 958-m Length	Estimated[a] Soil Berm Activity (μCi/g)	Estimated[b] Groundwater Activity at 10 m (μCi/cc)	10 CFR 20 NRC Limits for Uncontrolled Releases (μCi/cc)
H-3	1.23E+01	2.278E-02	4.66E-08	6.85E-08	1.00E-03
Be-10	1.50E+06	1.976E-04	4.04E-10	4.23E-10	2.00E-05
C-14	5.73E+03	1.546E+02	3.16E-04	4.43E-04	3.00E-05
Na-22	2.60E+00	3.283E+02	6.72E-04	5.54E-05	6.00E-06
Al-26	7.15E+05	2.202E-01	4.50E-07	4.58E-08	6.00E-06
Cl-36	3.01E+05	8.593E-02	1.76E-07	4.54E-07	2.00E-05
Ar-39	2.69E+02	3.795E+02	7.76E-04	2.00E-03	NA
K-40	1.27E+09	2.684E-03	5.48E-09	6.50E-09	4.00E-06
Ca-41	1.03E+05	8.448E-01	1.73E-06	1.76E-07	6.00E-05
Mn-53	3.70E+06	1.639E-03	3.35E-09	3.14E-09	7.00E-04
Mn-54	8.54E-01	2.861E+05	5.85E-01	1.64E-04	3.00E-05
Fe-55	2.73E+00	2.202E+04	4.50E-02	1.09E-15	1.00E-04
	Total =	3.09E+05			

[a] Uniform distribution of isotopes over its entire length and diameter in the proposed SNS berm.
[b] Groundwater activities at a 32.8-ft (10-m) boundary 10 years after the end of 30 years of operations, assuming no retardation of the isotope migration by soils.
NA - Not available.

Based on very conservative assumptions incorporated into this evaluation (see Section 5.2.1.3), only 3 (^{14}C, ^{22}Na, and ^{54}Mn) of 12 isotopes would have any potential for affecting groundwater quality within a 32.8-ft (10-m) zone of influence at the proposed SNS facility. In the case of ^{22}Na and ^{54}Mn, these isotopes have short half-lives of 2.6 years and 0.854 years, respectively. If less conservative but realistic retardation factors are applied to account for slowed contaminant migration through ORNL-type soils, then these isotopes would decay to below levels of concern before they might reach the 32.8-ft (10-m) boundary.

Lastly, the only nuclide of potential concern would be ^{14}C because of its mobility, long half-life, and high specific activity. If a realistic (i.e., not conservative) groundwater travel time is used and a retardation factor is applied, the decay in ^{14}C would still result in approximately a 22 percent reduction. This concentration would still be above drinking water limits, but it does not account for a corresponding natural dilution (5 to 208 times) due to the increase in travel time of 50 to 2080.

A very conservative treatment of many factors and assumptions is used in this evaluation. The net effect of this multiplication of conservative assumptions is to overestimate the potential concentrations in the groundwater below the proposed SNS site by a factor of between 25 to over 100 times. When the predictions show that the radionuclides are below 10 Code of Federal Regulations (CFR) 20 NRC Dose Limits for an individual member of the public, there is a very high confidence level that these limits would never be exceeded during the post-operation period of the proposed SNS facility. In summary, this assessment indicates that an exceedance of drinking water limits for an actual receptor under realistic conditions would be highly unlikely (even for ^{14}C). If necessary, DOE would implement routine monitoring of the groundwater to ensure that nuclide migration would not occur. If required, modifications to the shield design of the proposed SNS would be incorporated to further protect against nuclide transport, including the placement of a crushed limestone interval covered by a geomembrane to protect and inhibit groundwater flow surrounding the tunnel (Dole 1998) [refer to Section 3.2.2.9]. Thus, operation of the proposed SNS would have minimal to no effect on intermediate and deep groundwater systems on the ORR.

5.2.3 CLIMATOLOGY AND AIR QUALITY

Impacts on the climate and air quality from the construction and operation of the SNS located on the proposed Chestnut Ridge site at DOE's ORR are described in the following sections.

5.2.3.1 Climatology

Construction and operation of the proposed SNS would not affect regional or localized climates within the Oak Ridge area. Emissions from the proposed SNS facility may affect meteorological measurements, air indices, or measurements taken for research projects at the nearby Walker Branch Watershed. These impacts are discussed in Section 5.2.8.

5.2.3.2 Air Quality

Only negligible impacts would occur to nonradiological air quality. The nonradiological air quality assessment is presented in this section, while airborne radiological releases are evaluated under human health impacts (refer to Section 5.2.9). Construction activities would create temporary impacts from fugitive dust during the early construction phase of the project. This impact would be greatest during the clearing, contouring, and excavation stages but would decrease within a relatively short time period. In addition, fugitive dust would be most elevated during work hours (with an assumed 10-hr work day). While no estimates of suspended particulate matter have been prepared, PM_{10} measurements are predicted to be minimal when normalized for the standard 24-hr period. Moreover, the proposed SNS site is located in a remote section of the ORR several miles from the reservation boundary. Temporary elevation of particulate matter during excavation would contribute less impact to off-site receptors than operations at local construction sites or landfill operations.

The primary nonradiological airborne release during operations at the proposed SNS would be combustion products derived from the use of natural gas. Peak usage of natural gas would be during winter months at an approximate rate of 1,447 lb/hr. Emission rates for the maximum use of natural gas at 4-MW operations are estimated in Table 5.2.3.2-1. The projected emission levels would be well below those required for prevention of significant deterioration (PSD) review (i.e., this "minor source" would not be subject to the PSD permitting process).

The EPA Screen 3 Model (version 96043) was employed to calculate the impact of the proposed SNS to air quality by comparing projected ambient concentrations from calculated emissions against the NAAQS. A simple approach was undertaken for a screening-level assessment of the impacts. It was conservatively assumed that all emissions (from 10 stacks) would emanate from one stack (on the target building), and the simple elevated terrain (with maximum terrain height equal to stack top height) option was selected. The above emission rates were incorporated into the model to provide the calculated distance and maximum concentration ($\mu g/m^3$) for a 1-hr average period. Conversion factors were applied to predict concentrations for longer periods corresponding to NAAQS parameters. Table 5.2.3.2-2 compares the projected ambient concentrations against the ambient air quality standards. Impacts to air quality at a 984-ft (300-m) site boundary from the burning of natural gas at the proposed SNS facility would be below all indicated limits. Adding maximum background concentrations to maximum projected impacts from the proposed SNS sources (a very conservative procedure since the two do not occur at the same location or time) also does not provide any violations of the NAAQS.

Five 200-kW diesel backup generators would be tested for short durations several times a year. Discharge from these generators is rated at 1,450 cfm at 910°F (487°C). Periodic discharges from these generator testings would not impact overall air quality, and impacts to air quality by the construction or operation of the proposed SNS would be negligible.

5.2.4 NOISE

Noise levels resulting from construction and operation of the proposed SNS within the affected environment are discussed in this section.

Noise levels would be elevated both during construction and during operation of the proposed SNS. Two types of noise may be emitted during the proposed SNS construction phase. Continuous moderate noise levels would

`

Table 5.2.3.2-1. Combustion products from natural-gas-fired boilers at the proposed SNS.

Combustion Products	Rate ($lb/10^6\ ft^3$)[a]	Total Load (lb/hr)[b]
SO_2	0.6	0.02
NO_x	100	3.49
CO	21	0.73
CO_2	1.2E+05	4184
Organic Compounds (total)	5.3	0.18
Particulate Matter (PM_{10})	12	0.42

[a] Emission factors from EPA AP42 for commercial boilers (rating: 0.3 to < 10^6 Btu/hr).
[b] Based on cumulative output of 10 boilers at the proposed SNS with total heat load of 34,870,000 Btu/hr.

Table 5.2.3.2-2. Impact of natural gas combustion at the proposed SNS.

NAAQS Compound	Period[a]	Estimate (μg/m³) at 984 ft (300 m)	Maximum Concentration[b]	Assumed Background (μg/m³) (Table 4.1.3.3-1)	Background + 300 m Location (μg/m³)	NAAQS Limits (μg/m³)
Sulfur dioxide (SO_2)	Annual[c]	0.1	0.8	13.3	13.4	80
	24-hr	1.0	10.0	85.0	86.0	365
	3-hr	2.4	22.7	403.7	406.1	1,300
Carbon monoxide (CO)	8-hr	69.0	644	5,693	5,762	10,000
	1-hr	99.0	921	11,967	12,066	40,000
Nitrogen dioxide (NO_2)[d]	Annual[c]	16.0	147	28.6	44.6	100
Particulate (PM_{10})	Annual[c]	1.9	17.7	33.0	34.9	50
	24-hr	23.0	212.0	69.0	92.0	150

[a] Factors used to convert from 1-hr averages to long periods taken from EPA 1977. Annual averages based on conservative 0.1 factor.
[b] Concentration at 984 ft (300 m) estimated boundary and maximum concentration [occurring at 174 ft (53 m)] estimated by EPA – Screen 3 Model (version 96043). Maximum concentration location is expected to be "on-site."
[c] Annual concentrations reflect 33% estimated (conservative) annual usage factor.
[d] Estimated concentration in this table includes all NO_x compounds and not only NO_2 for NAAQS.

be created during the period of construction activities. Earth-moving, transportation, and construction activities would produce peak noise levels as indicated in Table 3.2.2.12-1.

As Table 3.2.2.12-1 indicates, sound levels for a point source will decrease by 6 dBA for each doubling of distance [Department of Transportation (DOT) 1995]. Since the nearest public accommodations are considerably more than 400 ft (122 m) from the SNS site, the noise levels shown at 400 ft in Table 3.2.2.12-1 could serve as a very conservative estimate of peak noise levels anticipated off-site during construction. Comparison of the maximum 400-ft noise level of 84 dBA from this table to common sound levels shown in Figure 5.2.4-1 indicates that this maximum would be no greater than a “noisy urban” atmosphere or a household food blender. General construction noise levels of 55 to 77 dBA would be typical of a “commercial area” or normal speech. Thus, off-site construction sound levels should be typical of those most likely experienced by the general public.

Site traffic would contribute to elevated noise levels, but the incremental increase for the region would be insignificant, and site-specific levels would be elevated primarily during shift change. Moreover, traffic noise would not be a problem for people who live more than 100 to 200 ft (30 to 60 m) from lightly traveled roads (DOT 1995).

5.2.5 ECOLOGICAL RESOURCES

The effects of proposed SNS construction and operations on ecological resources are discussed in this section.

5.2.5.1 Terrestrial Resources

Preparation of the proposed SNS site for construction would result in clearing the existing vegetation, which is primarily mixed hardwood forest and pine plantations, from 110 acres (45 ha) of ORR land on Chestnut Ridge. The entire area of the proposed site would be cleared during the first year of construction. The timber harvested during site preparation would be sold. Areas that are not immediately required for the construction of facilities would be planted with grasses to minimize erosion.

Removal of vegetation would increase forest fragmentation; however, the area around the proposed SNS site would remain forested. In addition, current construction plans call for a minimum of forest clearing, which would reduce the fragmentation effects of the clear cutting. The specific locations of utility corridors are not known at this time; however, they would be constructed in existing rights-of-way whenever possible to reduce the area of land disturbance. The 161-kV electrical transmission line that would provide power to the proposed SNS is located less than 3,000 ft (914.4 m) west of the site, and the existing water main passes through the eastern end of the site. Other utilities, such as natural gas

> Federal policy on wetland protection is contained in Executive Order 11990. In addition, 10 CFR 1022 describes DOE’s implementation of this Executive Order. This order requires federal agencies to identify potential impacts to wetlands resulting from the proposed activities and to minimize these impacts. Where impacts cannot be avoided, action must be taken to mitigate the damage by repairing the damage or replacing the wetlands with an equal or greater amount of man-made wetland as much like the original wetland as possible. The current DOE policy is for no net decrease in the amount of wetlands as a result of DOE activities.

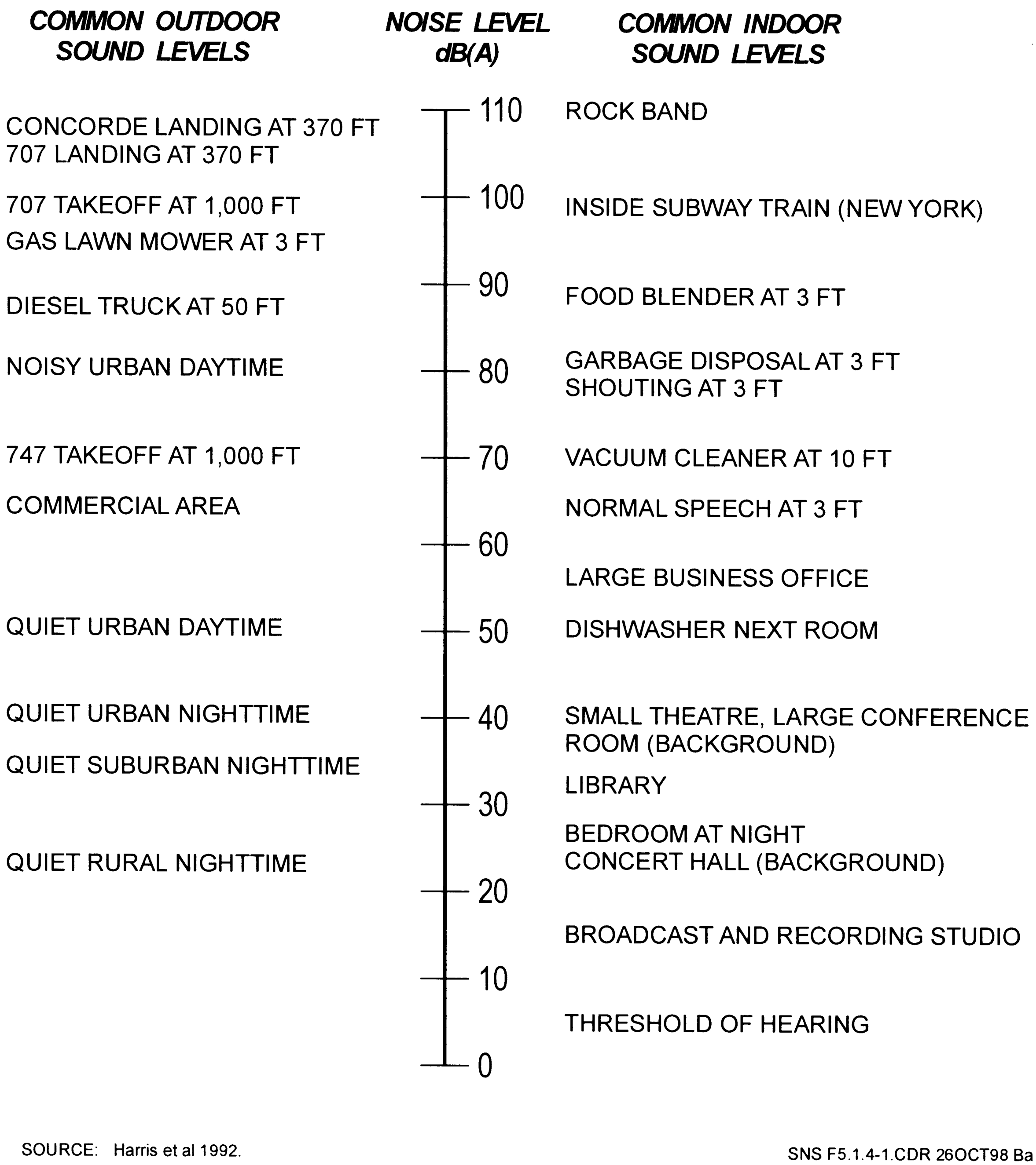

Figure 5.2.4-1. Common sound levels.

and telephone service, would be brought into the site along Chestnut Ridge Road.

The general vegetation cover on the ORR is approximately 80 percent forest (LMES 1996). Although movement of wildlife across the proposed site would be slightly disrupted, there would still be a continuously forested path across Chestnut Ridge. The 110-acre (45-ha) site represents less than one-half percent of the total forested area on the ORR.

Clearing operations for construction of the SNS may cause the direct loss of small animals. Also, wildlife would be displaced from cleared areas and the surrounding habitat. Large mammals would be mostly excluded from controlled areas by access control fences. While additional forest-edge habitat would be created, cleared land would represent long-term loss of habitat.

Construction and operation activities and the associated noise and human presence would disturb wildlife occupying areas adjacent to the proposed site. This could result in emigration of some sensitive species from the surrounding area, although many of the species would adjust to the disturbance. To help minimize disturbance to wildlife, construction machinery would be kept in proper operating condition, and workers would be prevented from entering undisturbed areas delineated before construction.

In summary, the potential effect of the proposed vegetation removal on terrestrial wildlife would be minimal.

The proposed SNS would operate on land where natural features have been largely removed or altered by construction activities. Consequently, proposed SNS operations would have a minimal effect on terrestrial resources at this location and in immediately adjacent areas.

5.2.5.2 Wetlands

Eight wetland areas are located in and around the proposed SNS site. There will be encroachment on three wetlands, totaling 0.23 acres (0.09 ha) of fill, for the upgrade of Chestnut Ridge Road. The retention basin (approximately 2 acres or 0.81 ha) for the proposed SNS cooling water may have indirect effects on wetland WONT1-1. Indirect effects on wetlands can occur during construction as a result of increased runoff and sedimentation. The implementation of proper construction techniques, including erosion control, would serve to minimize effects on the area.

The upgrade of Chestnut Ridge Road would require the filling of 0.23 acres (0.09 ha) of wetlands. The laying of utility lines may also encroach on a small area of these wetlands adjacent to the road. The 0.23 acres (0.09 ha) includes the southwest corner of WOM16, the southern half of WOM15, and all of WOM14. Wetland WOM16 covers approximately 2.36 acres (0.96 ha), which makes it the largest of the

> Federal policy on floodplain protection is contained in Executive Order 11988, *Floodplain Management*. In addition, 10 CFR 1022 describes DOE's Implementation of this Executive Order. This order requires federal agencies to ensure that potential effects of flood hazards and floodplain management are considered for actions undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable. Where impacts cannot be avoided, action must be taken to mitigate the damage and minimize the impact.

Wetlands Function: Wetlands perform several functions within an ecosystem, including groundwater recharge and discharge, flood flow alteration, sediment stabilization, nutrient removal and transformation, sediment and toxicant retention, production export, and provision of wildlife and aquatic species habitat. Not all functions will be performed in every wetland. The factors that affect wetland functions are numerous and include geographic and topographic location; wetland position in the watershed; water source and flow dynamics; substrate; and other physical, chemical, and biological characteristics of the wetland.

Wetland functions, as described by Adamus et al. (1991), that could be present in headwater wetlands include the following:

Flood flow alteration. The process by which peak flows from runoff, surface flow, and precipitation enter a wetland and are stored or delayed from their downstream movement.

Nutrient removal and transformation. The storage of nutrients (primarily nitrogen and phosphorus) within the sediment or plant substrate, the transformation of inorganic nutrients to their inorganic forms, and the transformation and removal of nitrogen (Adamus et al. 1991).

Sediment and toxicant retention: The process by which suspended solids and adsorbed contaminants are retained and deposited in a wetland.

Production export: The flushing of organic material from the wetland to downstream or adjacent waters.

Wildlife diversity: All wildlife species that are wetland dependant or that may use wetlands on a daily, seasonal, or intermittent basis.

three wetlands in this area. This wetland encompasses seeps and springs in the forested floodplain of White Oak Creek. Although there is diffuse groundwater discharge in a part of the southwest corner that would be filled, there are no discrete seeps or springs. This wetland is also habitat for two plant species, *Carex leptalea* and *Bartonia paniculatum*, that are uncommon in East Tennessee; however, these plants have not been observed in the area that would be filled. The functions of this wetland include provision of wildlife habitat, nutrient removal and transformations, and production export.

Wetland areas WOM14 and WOM15 are located adjacent to White Oak Creek and Chestnut Ridge Road and have a combined area of 0.06 acres (0.02 ha). Wetland WOM14 is a small, man-made depression that is seasonally saturated or ponded by storm runoff. It has no surface connection to other wetlands or streams. Its functions are probably limited to potential amphibian breeding habitat if the depth and duration of temporary ponding is sufficient. Wetland WOM15 is a spring-fed swale that empties into White Oak Creek. The southern half of this wetland would be filled for road construction. The functions performed by this wetland may include sediment and contaminant removal, nutrient removal and transformation, production export, and possibly amphibian breeding habitat.

During construction of the proposed SNS, wetlands WOM16 and WONT1-1 could be potentially affected by increased runoff and siltation. Appropriate mitigation measures, including control of runoff and use of silt fences, would be incorporated to minimize these effects. However, because of its close proximity to Chestnut Ridge Road, WOM16 would continue to receive increased runoff during rain events. The diversion of road runoff into stormwater control structures, such as vegetated swales, would minimize the volume of additional runoff and sediments entering the wetland.

All runoff and water discharges would be directed to the retention basin during operations at the proposed SNS. The outflow from this basin would not be channeled into the upper reaches of White Oak Creek (refer to Section 5.2.5.3). So, no effects to the wetlands from increased surface flows would be expected. However, wetland WONT1-1 may be indirectly affected by construction of the retention basin. Changes in the vegetation community can occur as a result of the clearing (creation of forest edge) and possible introduction of invasive, exotic species such as privet (*Ligustrum sinens*). These potential effects can be minimized by increasing the distance between the wetland and the holding pond as much as reasonably practicable.

Mitigation measures that would be considered include creation of a new wetland area along the stream channel of one of the tributaries of White Oak Creek or enlarging an existing wetland. One potential site may be the area around the existing springs in wetland WOM15. DOE would consult with the U.S. Army Corps of Engineers (USACOE) and the State of Tennessee to finalize the mitigation plan prior to the start of construction. Details of the mitigation measures would be included in the MAP (refer to Section 1.4).

Effects on the remaining four wetland areas (BCST2-1, WOM17, WOM18, and WONT2-1) would be minimal. These wetlands are not in areas that would be disturbed by construction of the proposed SNS. Proper control of runoff, especially during site preparation, would minimize effects on these wetland areas.
A formal floodplain/wetlands assessment document has been prepared for the proposed action at the ORNL site in accordance with the DOE regulations in 10 CFR 1022.12. This document is included as Appendix H of this FEIS.

5.2.5.3 Aquatic Resources

The proposed SNS site is located in the headwaters area of White Oak Creek. During land clearing for improvement of the access road and construction, there would be a potential for increased precipitation runoff and sediment loading in the creek. In addition, clear cutting of vegetation could expose the creek channel to increased solar radiation, which would increase the water temperature in the stream. Increasing the water temperature could disrupt the life cycle of cooler water fish, such as the banded sculpin and the blacknose dace. As a result, these species could be displaced by warmer water species migrating from the lower reaches of the creek.

DOE would establish a 100 to 200 ft (34 to 68 m) buffer zone around White Oak Creek. Trees within this buffer zone would not be cut, thus preserving the vegetative cover of the creek and avoiding increases in its water temperature. Runoff and erosion control measures, including silt fencing and preservation of native vegetation, would minimize the increased runoff and sediment load to the creek during construction. As a result of these measures, construction activities would have minimal effects on the aquatic resources in White Oak Creek.

No discharges from the proposed SNS to the headwaters of White Oak Creek would occur during operation of the proposed SNS. All surface runoff from the proposed SNS site would be directed to the retention basin. Steam condensate and cooling tower blowdown water would also be released to this basin. The basin would discharge up to 350 gpm (1,325 lpm) of water through a standpipe, and the discharge would be piped off-site. The discharge pipe would empty into White Oak Creek, south of Bethel Valley Road near the intersection of White Oak Creek Road and Melton Valley Access Road. Thus, no impacts on aquatic resources in the headwaters of White Oak Creek would be expected from the proposed SNS operations.

The cooling tower blowdown water would be elevated in temperature and would contain biocides and antiscaling agents. The makeup water for the cooling towers would be obtained from the potable water supply for the proposed SNS site; therefore, the blowdown would contain chlorine. The blowdown would be dechlorinated prior to its release into the retention basin. As described in Chapter 3, the retention basin would be designed to reduce the temperature of the blowdown to the ambient temperature of White Oak Creek (refer to Section 5.2.2.1.2).

5.2.5.4 Threatened and Endangered Species

The results of the survey of the proposed SNS site verified the presence of two protected plant species at three locations in the immediate vicinity of the proposed SNS site (refer to Section 4.1.5.4). These species are pink lady's slipper—a Tennessee endangered species due to commercial exploitation; and American ginseng—a threatened species in Tennessee. However, these plants are not located in areas expected to be heavily disturbed by construction or operation of the proposed SNS.

As stated in Section 4.1.5.4, the proposed SNS site encroaches on a NERP-designated Natural Area. This Natural Area, NA52, was established based on the presence of protected species and habitat that may be used by protected species. Approximately 20 percent of the 147 acres (59.5 ha) of NA52 overlap the proposed SNS site. The vegetation in this area would be cleared during construction.

The U.S. Fish and Wildlife Services, in response to DOE's informal consultation letter, submitted a list of federally listed or proposed endangered or threatened species that may occur in the project impact area (see Appendix D). However, no indications that these species occur at the ORNL site have been found to date.

A systematic survey of the potential habitat areas for protected species would be conducted prior to the start of land clearing for utility corridors, access roads, and construction. Because definitive identifications of many protected plants can be made only when they are flowering, this survey would extend over the spring, summer, and fall seasons to maximize the probability of finding these plants. If found in areas subject to disturbance, DOE would begin formal consultation with the USFWS and the State of Tennessee and implement an appropriate conservation plan to protect them during construction and operation of the proposed SNS. Possible conservation measures could include placing a fence around the habitat containing protected plants so the construction workers and equipment cannot cause damage, or transplanting the plants to areas of similar habitat. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4). Overall, impacts on protected species by the proposed action are expected to be minimal.

5.2.6 SOCIOECONOMIC AND DEMOGRAPHIC ENVIRONMENT

The socioeconomic effects section identifies whether construction and operation of the proposed SNS and associated worker in-migration from outside the ROI may adversely affect regional services and infrastructure. It also presents an estimate of the financial effects (employment, income, taxes, and economic output) that would be generated locally in the form of worker salaries, indirect effects, and induced effects. Unless otherwise noted, economic effects are described in escalated-year dollars.

The ROI associated with the proposed SNS at the ORNL site includes Anderson, Knox, Loudon, and Roane Counties in Tennessee. This 1,436-mi² (3,719-km²) region was selected because it is the region within which at least 90 percent of Oak Ridge workers currently reside. It is, therefore, the area within which the majority of socioeconomic impacts are expected to occur. Socioeconomic effects beyond the ROI area are generally expected to be minor.

The total local construction cost is estimated to be approximately $332 million (escalated dollars), and the peak construction year would be 2002, when 578 workers would be on-site (Brown 1998a). Of this total, about three-fourths (433 individuals) would likely be hired from the local area, and 144 would come from outside the ROI. An approximate average of 300 workers per year would be on-site, including all construction, management, engineering design personnel, and other technical and commissioning staff. Construction of the 1-MW proposed SNS is the bounding case for analysis of construction effects. If the SNS is upgraded to 4 MW, additional construction would occur, but this would be much less than the effects associated with the initial construction of the 1-MW SNS.

Operations of the proposed SNS at 1 MW would begin in the year 2006 with a staff of 250 persons. Later, if the proposed SNS is upgraded to 4 MW, 375 persons would be employed. The 4-MW case is used for this analysis as the bounding case. The effects of the 1-MW proposed SNS on the ROI would be similar but slightly less than the 4-MW case.

5.2.6.1 Demographic Characteristics

It is assumed that approximately 75 percent of all construction workers would come from the local area (Brown 1998a). Most of the construction workers would be general craft laborers, and the specialized technical components would be contracted out and fabricated in places not yet known. All locally hired construction workers would commute to the job site from existing residences and would not relocate closer to the site. The experience with other major construction projects has been that most in-migrating workers would temporarily move to the project area but would usually commute home periodically or on weekends. Generally, these individuals would not bring families to the ROI for the construction period. However, even if all of the in-migrating workers brought families into the area, the total (temporary) population increase would be less than 500 persons (including spouses and children) in the peak year. This would be a temporary increase in population of less than 0.01 percent and is, therefore, negligible.

People with the technical expertise needed to operate the proposed SNS currently reside in the

ROI. However, it is also expected that some plant operators would come from outside the local area. It is assumed that about half of the 375-person operating workforce (for the bounding 4-MW case) would come from outside the area. It is further assumed that these households would be the same size as the national average because it is not known from where they would in-migrate. It is conservatively estimated that in 2006, the total population increase associated with operations would be about 600 individuals, including spouses and children. The facility operators would be "permanent" residents of the ROI, and little additional in-migration would occur in subsequent years. The population increase associated with construction and operations would represent approximately 0.01 percent of the local population and is, therefore, negligible.

5.2.6.2 Housing

With about 14,600 vacant dwelling units (refer to Section 4.1.6.2) in the four-county ROI, workers should be able to find apartments to rent or houses to purchase easily. This is especially true because of recent downsizing of DOE program operations on the ORR. The effects on housing would be minor.

5.2.6.3 Infrastructure

Potential effects on infrastructure are closely tied to population growth. Because the expected permanent in-migration would be only 600 individuals, impacts to infrastructure would be relatively minimal. There are 138 schools with an enrollment of over 75,000 students in the area. The addition of less than 300 children to the ROI would be a minor effect. Even if all 300 children attended schools in Knox County, the current teacher-student ratio of 1:19 would be unchanged. Also, effects would be minimal for police and fire protection, health care, and other services.

5.2.6.4 Local Economy

Design of the SNS would begin in 1999, and the first construction managers and workers would begin work in FY 2000. The majority of the construction would occur from FY 2001 through FY 2004, with the peak construction employment occurring in FY 2002. Testing of the SNS would be from FY 2003 through FY 2005. Operations are planned to begin by the end of FY 2005; FY 2006 would be the first full year of operations (see Figure 3.2.2-1).

Table 5.2.6.4-1 presents the results of the IMPLAN modeling for the period 1999 through 2006. Economic benefits in the form of jobs, wages, business taxes, and income would begin to accrue during the first year of the project in FY 1999. These economic benefits in the ROI would increase as construction and other associated project activities increase. Design and construction employment would be highest in FY 2002, and there would be an estimated 1,499 total (direct, indirect, and induced) new jobs created at ORNL. This trend would begin to diminish in FY 2003 as design and construction employment decreased and would continue to decrease until construction is completed in FY 2004. Facility operations would begin in FY 2005. Operations would reflect substantial regional spending for operator salaries, supplies, utilities, and administrative costs.

The SNS is planned to operate for 40 years. If the level of operation is the same as the 4-MW case measured in the first full year (FY 2006), it is estimated that facility operation would continue to support 1,704 direct, indirect, and

Table 5.2.6.4-1. ORNL IMPLAN modeling results—construction and operations impacts.

	1999	2000	2001	2002	2003	2004	2005	2006
Employment								
Direct	80	168	387	460	320	213	29	744
Indirect	96	172	413	517	372	255	35	328
Induced	95	178	423	522	372	253	35	632
Total	271	518	1,223	1,499	1,064	722	99	1,704
Wages								
Direct	$5,393,195	$10,461,635	$25,209,789	$31,551,929	$22,870,276	$15,825,858	$2,214,385	$42,288,062
Indirect	$2,602,596	$4,789,126	$11,720,166	$14,947,307	$10,963,754	$7,675,011	$1,076,888	$10,192,999
Induced	$2,153,266	$4,093,319	$9,872,770	$12,431,138	$9,025,748	$6,255,302	$874,191	$16,185,791
Total	$10,149,057	$19,344,080	$46,822,724	$58,930,373	$42,859,777	$29,756,171	$4,165,464	$68,666,850
Business Tax								
Direct	$115,218	$237,187	$563,537	$691,797	$495,116	$338,324	$47,327	$2,147,003
Indirect	$521,081	$949,166	$2,314,978	$2,941,707	$2,148,064	$1,496,606	$208,816	$1,397,183
Induced	$531,318	$1,008,037	$2,431,249	$3,048,597	$2,208,599	$1,527,191	$212,926	$3,932,794
Total	$1,167,617	$2,194,390	$5,309,763	$6,682,100	$4,851,779	$3,362,121	$469,070	$7,476,980
Income								
Direct	$6,121,350	$11,835,876	$28,545,240	$35,765,984	$25,942,069	$17,962,928	$2,513,568	$44,391,954
Indirect	$3,012,179	$5,543,681	$13,576,165	$17,327,200	$12,718,333	$8,909,689	$1,250,971	$12,374,347
Induced	$2,545,442	$4,840,266	$11,701,405	$14,798,082	$10,681,986	$7,405,248	$1,035,187	$19,171,977
Total	$11,678,971	$22,219,822	$53,822,810	$67,801,266	$49,342,388	$34,277,864	$4,799,726	$75,938,279
Output								
Direct	$23,268,421	$43,760,128	$106,356,197	$134,502,188	$98,102,769	$68,290,104	$9,560,702	$92,847,043
Indirect	$7,305,926	$13,581,143	$33,109,038	$42,039,272	$30,745,296	$21,462,300	$3,008,388	$30,427,843
Induced	$7,029,522	$13,372,419	$32,340,621	$40,665,590	$29,544,359	$20,488,217	$2,864,941	$53,074,479
Total	$37,603,869	$70,713,690	$171,805,856	$217,207,050	$158,392,423	$110,240,621	$15,434,031	$176,349,365

induced jobs for each of the following years of operation. Other annual operations effects would include $68.7 million in local wages, $7.5 million in business taxes, $75.9 million in personal income, and $176.3 million in total output.

Construction of the facility would create new jobs and could potentially lower the region's total unemployment rate from about 3.2 percent to 3.0 percent. During operations, the unemployment rate would likely decrease further, although this would depend on whether construction workers and engineers (unemployed following project completion) stay in the ROI. The effects of operating the 1-MW proposed SNS would be similar but slightly lower.

5.2.6.5 Environmental Justice

As identified in Figures 4.1.6.5-1 and 4.1.6.5-2, minority populations and low-income populations reside within 50 miles (80 km) of the proposed SNS site. For environmental justice impacts to occur, there must be high and adverse human health or environmental effects that disproportionately affect minority populations or low-income populations.

The human health and safety analyses show that hazardous chemical and radiological releases from normal operations of the proposed SNS at 1-MW and 4-MW power levels would be within regulatory limits. Annual radiological doses are given in Section 5.2.9, and the data show that normal air emissions of the 1-MW proposed SNS would be negligible and would not result in adverse human health or environmental effects on the off-site public. Therefore, operation of the proposed SNS would not have disproportionately high and adverse effects on minority or low-income populations.

Radiation doses to the public from both normal operations and accident conditions would not create high and adverse impacts. Less than one (0.3) LCF is calculated at the 4-MW power level over a 40-year operations period. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the calculated number of LCFs would be reduced (refer to Section 5.2.9.2.1). An LCF is a cumulative measure from the entire population (within 50 miles or 80 km radius) of about 880,000 people used for comparing alternatives and does not necessarily indicate that a fatality would occur (refer to Section 5.2.9.2.1). Also, there are 25 accident scenarios that would result in airborne releases. The consequences of most of these accidents would be negligible at power levels of both 1 MW and 4 MW. Three accidents are calculated to induce LCFs in the off-site population. The prevailing winds follow the general topography of the ridges. Up-valley winds come from the southwest during the daytime, and down-valley winds come from the northeast during the nighttime (refer to Figure 4.1.3-2). Figures 4.1.6.5-1 and 4.1.6.5-2 show a concentration of minority and low-income population and nonminority higher income population northeast of the proposed SNS site in the path of the daytime prevailing wind. These figures indicate that no concentrations of minority or low-income population are located southwest (path of the nighttime prevailing wind) of the proposed SNS site. The public, including minority and low-income persons, could be in the path of an off-site airborne release. However, the analysis has shown that there would not be high and/or adverse impacts to any of the population; therefore, there would be no disproportionate risk of significantly high and adverse impacts to minority and low-income populations.

A number of uncertainties are associated with the evaluation of potential impacts due to subsistence consumption. ANL developed an article reviewing the literature on subsistence consumption (Elliot 1994) and found that (1) "the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns. … At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level;" (2) "a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations;" (3) "the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases, the studies were not motivated by minority exposure concerns;" and (4) "the majority populations were not significantly higher than for the population as a whole." Specific data on subsistence living are not available for the ORR region, and DOE is unaware of any subsistence populations residing in the vicinity of the proposed SNS site. Therefore, no adverse impacts to such populations are expected.

To assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the spring of 1996. The newsletter is available in the public reading rooms. Three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation;" (2) "to provide information about projects and programs at DOE and other federal and state agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation;" and (3) "to receive relevant information from readers." In addition to the newsletter, DOE has a new project under way to identify what information is being collected on subsistence consumption by other federal agencies and to serve as a clearinghouse for such information (DOE 1996e).

No discharges of radioactive water to surface waters would occur because these liquids would be trucked to existing waste processing facilities at ORNL. These facilities and the management processes for these wastes are described in Section 5.2.11. All chemical releases would be regulated by NPDES permits and would be in compliance with federal and state regulations. As such, there would be no incremental effects on fish or other edible aquatic life in areas surrounding the proposed SNS site.

The analyses indicate that socioeconomic changes resulting from implementing the proposed SNS would not lead to environmental justice impacts. The proposed SNS project would provide economic benefits through generating additional employment and income in the affected region (refer to Table 5.2.6.4-1). There would be increased traffic congestion; however, this impact would not disproportionately affect minority or low-income communities because traffic patterns would not be different between low income and minority populations and the rest of the surrounding population (see Section 5.2.10.1). Overall, there is nothing from the construction or operation of the proposed SNS that would pose high and adverse human health or environmental effects that disproportionately affect minority and low-income populations.

5.2.7 CULTURAL RESOURCES

Surface and subsurface cultural resources can be affected by a number of activities. Surface resources such as standing structures, TCPs, artifacts, and landscape features are especially susceptible to damage by activities that involve their direct physical impact by objects such as heavy equipment. These activities include land clearing and grading. Subsurface artifacts and the archaeological context of the artifacts can be damaged by any activity that disturbs the soil. Such activities include the clearing of vegetation, excavations, and compression of soil by heavy objects resting or moving on the ground surface.

The SNS design team has not established the areas where construction or improvement of utility corridors would be necessary to support the proposed SNS, and the full route of the southwest access road has not been determined. As a result, the effects of the proposed action on cultural resources in these areas cannot be assessed at this time. If the site at ORNL were chosen for implementation of the proposed action, the SNS design team would establish the final routes of the southwest access road and utility corridors. A cultural resources survey and an assessment of potential effects on cultural resources would be conducted. Appropriate measures would be implemented to mitigate any identified effects. The survey and mitigation would be implemented prior to the initiation of construction-related activities in these areas. The mitigation measures would include avoidance (e.g. choosing another route or fencing a prehistoric site to protect it), where possible, or data recovery operations. The data recovery operations would include detailed recording of surface features and/or archaeological excavation. Details of the mitigation measures to be implemented would be included in the MAP (refer to Section 1.4).

5.2.7.1 Prehistoric Resources

No prehistoric archaeological sites have been identified on the 110-acre (45-ha) proposed SNS site at ORNL. As a result, implementation of the proposed action on this site would have no effect on prehistoric cultural resources listed on or eligible for listing on the NRHP.

Loci FN-1, FN-1A, and FN-7 denote isolated occurrences of prehistoric artifacts in the vicinity of the proposed SNS site. In addition, a prehistoric component was identified at 40RE488, which is also located in the vicinity of the proposed SNS site. Because of their locations, the isolated occurrence loci may be destroyed by heavy equipment movements. Access road improvements under the proposed action may destroy the east portion of the prehistoric component at 40RE488. Neither these loci nor the site component are listed on or considered to be eligible for listing on the NRHP. Consequently, their destruction would not represent an effect on prehistoric cultural resources.

5.2.7.2 Historic Resources

No Historic Period archaeological sites, structures, or features have been identified on the 110-acre (45-ha) proposed SNS site at ORNL. As a result, implementation of the proposed action on this site would have no effect on Historic Period cultural remains listed on or eligible for listing on the NRHP.

A Historic Period archaeological component has been identified in the vicinity of the proposed SNS site at 40RE488. This site is in an area slated for access road improvements under the proposed action. The east portion of this previously disturbed late 19th or early 20th century farmstead component may be destroyed by the proposed road improvements. However, this component is not listed on or considered to be eligible for listing on the NRHP. As a result, partial destruction of the component by road improvements would not be an effect on a cultural resource.

5.2.7.3 Traditional Cultural Properties

DOE-ORO has consulted with the Eastern Band of the Cherokee concerning the presence of TCPs on the ORR. No TCPs of special sensitivity or concern to the Cherokee are known to exist anywhere on the ORR. Consequently, no TCPs would be affected by implementation of the proposed action on the proposed SNS site at ORNL.

40RE488: A Multicomponent Archaeological Site

Many archaeological sites in the United States contain the separate and distinctive material remains of occupations by different cultural groups. Each of these occupations may be associated with a particular period in time, and the individual occupations may be separated from each other in time by thousands of years. In American archaeology, each culturally and temporally distinctive occupation of a single site is referred to as a component. One archaeological site may have a single component, but another may have numerous components. Sites with more than one component are referred to as multicomponent sites.

Site 40RE488 is a multicomponent site. It contains archaeological remains indicative of a prehistoric occupation, and it was also the site of a late 19th or early 20th century Anglo-American occupation. Potential effects on the prehistoric component at this site are assessed in Section 5.2.7.1, and potential effects on the Anglo-American component are assessed in Section 5.2.7.2.

5.2.8 LAND USE

Land use in the vicinity of the ORR, within the boundaries of the reservation including ORNL, and on the proposed SNS site are assessed in this section for potential effects of the proposed action. The assessments cover potential effects on current land uses and zoning for future land use. Furthermore, the potential effects of the proposed action on parklands, nature preserves, major recreational resources, and visual resources are assessed.

5.2.8.1 Current Land Use

Current land use in the area surrounding the ORR is driven by the relationship between existing land characteristics and socioeconomic forces acting at the local and regional levels. Similarly, current land use on the ORR results from selectively using the existing characteristics of the land to meet various DOE mission requirements. The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic land characteristics and other forces that influence land use in these areas. Consequently, implementation of the proposed action on the proposed SNS site at ORNL would have no reasonably discernible effects on land use in the vicinity of the ORR and throughout most of the reservation. However, current uses of the land within the proposed SNS site and in nearby areas would be more subject to effects.

The proposed SNS site and adjoining land are located within a current land use category referred to as Mixed Research/Future Initiatives. This category includes most of the Oak Ridge NERP and applies to predominantly undeveloped land that is used or available for use in environmental field research. This land is also reserved for future DOE initiatives, including new research facilities. With the exception of Chestnut Ridge Road, utility corridors, a system of unimproved access roads, and a few other features, this area is undeveloped land that has been returning to its natural state since 1942. Implementation of the proposed action would introduce large-scale development to the proposed SNS site, utility corridors, and rights-of-way. However, this would result in minimal overall effects on undeveloped ORR land, because approximately 64 percent of the 34,516 acres (13,794 ha) of land on the reservation is undeveloped.

DOE has a federally mandated role as trustee of the natural and cultural resources on its lands. The use of undeveloped land for the SNS is proposed only because no previously developed ORR lands that meet project requirements are available.

Construction and operation of the proposed SNS would effectively change land use on the proposed SNS site from the current Mixed Research/Future Initiatives use category to the Institutional/Research category. In addition, the current uses of land within planned utility corridors and road rights-of-way would be changed from their current uses to these new infrastructure uses.

5.2.8.1.1 Walker Branch Watershed

The National Oceanic and Atmospheric Administration/Atmospheric Turbulence and Diffusion Division (NOAA/ATDD) is conducting the Temperate Deciduous Forest Continuous Monitoring Program (TDFCMP) in the Walker Branch Watershed. This project is measuring the continuous exchange of CO_2, water vapor, and energy between the deciduous forest in the Walker Branch Watershed and the atmosphere. The aim of the program is to continuously monitor these exchanges over a long period of time to gain a better understanding of local, regional, and global carbon budgets and the effects of elevated atmospheric CO_2 on temperate forests worldwide.

The facility heating system for the proposed SNS would include ten natural gas boiler units with ten small stacks. The operation of these units would result in the emission of combustion products to the atmosphere. These products would include CO_2, water vapor, and NO_x. Heavy equipment and automobile traffic associated with proposed SNS construction and operations would produce additional CO_2. Minor sources such as chain saws, mowing equipment, and diesel-powered electric generators may be used during construction and operations. Construction would begin in the year 2000, and operation of the proposed SNS facility would begin in late 2005.

The monitoring instruments for the TDFCMP are located 0.75 miles (1.2 km) east of the proposed SNS site. The prevailing winds blow from the proposed SNS site to the east-northeast toward the Walker Branch Watershed and the instrument stations during the daytime hours. Wind movement from the proposed SNS site towards the Walker Branch Watershed is also a function of current weather conditions. Consequently, the CO_2 from the proposed SNS could be transported to the monitoring instruments in the Walker Branch Watershed. It was recognized that this could affect the quality of the CO_2 monitoring data being collected, because some measurements would reflect activity from the proposed SNS instead of the physical, chemical, and biological activity in the forest biomass and soils of the Walker Branch Watershed. Furthermore, the presence of these nonrepresentative measurements could hinder comparisons of data collected after the start of construction of the proposed SNS to monitoring data collected prior to construction and operation.

Air quality modeling was performed to provide a preliminary assessment of the potential effects the proposed SNS boiler stack emissions would have on CO_2, NO_x, and water vapor monitoring data collected at the NOAA/ATDD research tower in the Walker Branch Watershed area. This modeling was conservative in nature, essentially reflecting the results of a worst-case scenario. Basic assumptions in the modeling effort were operation of the proposed SNS at a fully upgraded power of 4 MW and continuous annual operation of the natural gas boilers at their full rated capacity. This level of operation would consume 1,447 lb/hr of natural gas and emit 4,184 lb/hr of CO_2. The 1991 meteorological data input to the model were collected at the NOAA/ATDD tower in the Walker Branch Watershed area. These data were 1 year of 15-minute averages for wind direction, mean wind speed, ambient temperature, solar radiation, and sigma-theta. Missing data were filled by using data from nearby monitoring towers or by averaging surrounding period data for short missing periods. The full report on the results of the air quality modeling is in Appendix I.

The modeling indicated that local winds would transport CO_2 toward the NOAA/ATDD tower 15 to 20 percent of the time. The maximum 15-minute average CO_2 detection at the monitoring tower would be 27,569 μg/hr.

NOAA/ATDD has determined a threshold limit to serve as an indicator of potential effects of the proposed SNS on the quality of CO_2 monitoring data for the Walker Branch Watershed. This threshold is any amount > 6680 $\mu g/m^3$, which is 1 percent of the background level of CO_2 at the Walker Branch Watershed. A number of the modeled 15-minute average CO_2 measurements at the NOAA/ATDD tower exceed the established threshold. The numbers of modeled CO_2 measurements that exceed the threshold are listed in Table 5.2.8.1.1-1.

These results reflect a worst-case scenario, as previously noted. Normal operating conditions may produce fewer exceedances. Nonetheless, the presence of these measurements indicates that emissions from the proposed SNS boiler stacks would adversely affect the quality and temporal comparability of the CO_2 monitoring data collected under the TDFCMP.

The effects of CO_2 from construction equipment and automobiles on TDFCMP monitoring data are not entirely known. During construction of

Table 5.2.8.1.1-1. Modeled CO_2 measurements exceeding the effects threshold (6,680 $\mu g/m^3$) at the NOAA/ATDD tower in the Walker Branch Watershed.

Measurement Period (Based on 1991 Data)	Total Measurements in Period	Number of Measurements Exceeding Threshold	Percent of Measurements Exceeding Threshold
January – March	8,760	184	2.10
April – June	8,760	258	2.95
June- September	8,760	317	3.62
October – December	8,760	212	2.42
Annual Average	35,040	971	2.77

the proposed SNS, workers could park their personal vehicles at parking lots on the floor of Bethel Valley. The CO_2 emissions from these vehicles would be expected to have little more effect on TDFCMP monitoring than current traffic in the Bethel Valley Road area. However, emissions from on-site construction vehicles and the parking of automobiles at the proposed SNS site after operational startup could further affect TDFCMP monitoring data.

Two approaches to mitigating the adverse effects of CO_2 emissions from the proposed SNS on TDFCMP data are being considered.

- Relocate the NOAA/ATDD meteorological monitoring tower to a Walker Branch Watershed location less susceptible to the effects of CO_2 emissions from the proposed SNS or build a new tower at this new location.
- Eliminate CO_2 emissions from the proposed SNS heating system by installing electric heat pumps rather than natural gas boilers.

Proper relocation of the meteorological monitoring tower would have the potential to mitigate effects on CO_2 readings from both construction and operation of the SNS. These effects would potentially result from emissions by boiler stacks in the operational SNS heating system, vehicles, and minor sources.

The use of electric heat pumps instead of natural gas boilers would eliminate all CO_2 emissions and effects from direct operation of the SNS heating system, which would be the largest and most continuous emitter of CO_2. However, this option would not mitigate the effects of vehicle emissions on CO_2 readings during construction and operation of the SNS. In addition, it would not mitigate any effects that might result from minor sources during SNS construction and operations.

It is anticipated that the effects of the proposed SNS on CO_2 monitoring at the NOAA/ATDD tower would be minimal after implementation of a mitigation measure. Details of the mitigation measures to be implemented would be included in the MAP (refer to Section 1.4).

The cooling towers at the proposed SNS would emit water vapor to the atmosphere. Modeling indicated that the maximum 15-minute average detection of the proposed SNS water vapor at the NOAA/ATDD monitoring tower would be 1.04 g/m^3 of air. Although the results of the modeling did not allow an assessment of specific effects on TDFCMP monitoring data, effects on data quality and comparability may occur. Such effects could be mitigated by moving the NOAA/ATDD monitoring tower to a Walker Branch Watershed location less susceptible to them or by building a new tower at this new location.

The boiler stacks at the proposed SNS would emit NO_x at a rate of 3.48 lb/hr. Modeling indicated that the maximum 15-minute average detection of NO_x from the proposed SNS boilers at the NOAA/ATDD monitoring tower would be 23 $\mu g/m^3$ of air. NOAA/ATDD has indicated that these low levels would have minimal effects on their monitoring efforts in the Walker Branch Watershed.

The ORNL-Environmental Sciences Division (ESD) has nine major ecological research projects in the Walker Branch Watershed. Most of these projects depend on data inputs from the long-term NOAA/ATDD atmospheric and deposition monitoring sites associated with the watershed. Although these sites are located on the side of the Walker Branch Watershed nearest to the proposed SNS site, their data are considered to be representative of the entire watershed.

Emissions from the natural gas boilers at the proposed SNS would adversely affect CO_2 measurements at the NOAA/ATDD tower in the Walker Branch Watershed. Emissions of CO_2 from construction equipment and automobiles may also affect these measurements. If such nonrepresentative data were used in current ecological research projects, they could result in inaccurate experimental results. These projects would be further affected because the data obtained and the experimental results would not be comparable to data and results obtained prior to construction and operation of the proposed SNS.

One of the nine current ecological research projects in the Walker Branch Watershed would be adversely affected by the incorporation of nonrepresentative CO_2 data from the NOAA/ ATDD tower (refer to Table 4.1.8.2-1). Project No. C-9 is a long-term project (>10 years) that incorporates CO_2 exchange measurements from the tower into the modeling of ecosystem carbon cycle processes. After implementation of a mitigation option, it is anticipated that these effects would be minimal.

Water vapor emissions from the proposed SNS cooling towers may affect ORNL-ESD ecological research projects in the Walker Branch Watershed. The current research efforts that may be adversely affected are Project Nos. C-1 and C-2, which are long-term projects extending beyond the fiscal year (FY) 2005 start date for operation of the proposed SNS and its cooling towers. Project Nos. C-3, C-4, C-6, and C-9 would not be affected because the current efforts on these projects would be completed by FY 2005.

5.2.8.2 Future Land Use

The land on the proposed SNS site and adjacent land are zoned as Mixed Research/Future Initiatives. This DOE zoning allows for a mixture of environmental research in the NERP, which includes all of the proposed SNS site land, with the construction and operation of future research facilities. Construction of the proposed SNS would be compatible with this zoning. Consequently, implementation of the proposed action would have no potential effects relevant to current DOE zoning of the proposed SNS site.

Portions of the proposed SNS site would become contaminated with pollutants from operations. Current plans call for in-situ decommissioning of the SNS when its operational life cycle is completed. As a result of in-situ decommissioning, some contaminated components would remain in place on the SNS site. This could limit the future use of land on the site for other purposes. Construction and operation of the SNS could limit the future use of land areas adjacent to the SNS site.

The zoning of the proposed SNS site and adjacent land is currently overlain by the buffer zone for the Walker Branch Watershed (Figure 4.1.8.2-2). The purpose of this buffer zone is to exclude from its boundaries any future activities and operations that could adversely affect environmental monitoring and experiments in the Walker Branch Watershed. The entire proposed SNS site is located within this buffer zone.

Construction and operation of the proposed SNS would adversely affect on-going and future environmental monitoring and research efforts in the Walker Branch Watershed, as indicated in Section 5.2.8.1.1 and the following subsection. Consequently, construction and operation of the proposed SNS on the preferred site at ORNL would be at variance with the intended purpose of the Walker Branch Watershed buffer zone.

The Reservation Management Organization (RMO) has been charged with reviewing proposed activities in the Walker Branch Watershed buffer zone (refer to Section 4.1.8.3). After reviewing the ORNL siting options for the proposed SNS, the RMO has recommended use of the preferred site within the Walker Branch Watershed buffer zone for construction of the proposed SNS (Teer 1997: 1). The site selection report, which documents the process used for selection and recommendation of the preferred proposed SNS site at ORNL, is in Appendix B.

5.2.8.2.1 Walker Branch Watershed

The TDFCMP is a long-term monitoring project that NOAA/ATDD plans to continue for many years (> 10 years) into the future. Operation of the proposed SNS over a 40-year period would have continuing adverse effects on CO_2 monitoring under the TDFCMP. The potential effects would be the same as those indicated in Section 5.2.8.1.1, and they would be mitigated by implementing one of the options identified in that section of the FEIS. After implementation of a mitigation measure, it is anticipated that the effects of the proposed SNS on CO_2 monitoring would be minimal.

A number of the current ORNL-ESD ecological research projects in the Walker Branch Watershed are expected to continue for many years. Other projects are expected to generate closely related follow-on work. Several major ORNL-ESD proposals for future ecological research in the Walker Branch Watershed are pending, and a number of the future research initiatives identified in the ORNL-ESD Strategic Plan would be tied to the historical research record and an understanding of ecological processes gained on the Oak Ridge NERP, including the Walker Branch Watershed.

Project No. C-9 is a long-term effort that would be adversely affected by the future incorporation of nonrepresentative CO_2 data from the NOAA/ATDD tower into its modeling of ecosystem carbon cycling processes (refer to Table 4.1.8.2-1). Project No. C-7 involves theoretical studies of CO_2 and energy exchange in the Walker Branch Watershed ecosystem. A proposal is anticipated to continue this project beyond the current FY 1999 completion date. This project could also be adversely affected by the incorporation of nonrepresentative CO_2 data from the NOAA/ATDD tower, especially if the project extends beyond late 2005 when the proposed SNS operations begin. After implementation of a mitigation option specified in Section 5.2.8.1.1, it is anticipated that the effects on both projects would be minimal.

Water vapor emissions from the proposed SNS cooling towers may affect future TDFCMP monitoring data and future ORNL-ESD ecological research projects in the Walker Branch Watershed. These potential effects would be the same as those indicated in Section 5.2.8.1.1.

These water vapor emissions could affect ORNL-ESD Project Nos. C-1 and C-2, which are long-term projects that would continue for more than 10 years. Project No. C-4, a priority subject for long-term research, could also be affected. Anticipated follow-on work on Project Nos. C-3 and C-8 could also be affected, but only if these efforts extend beyond the start date for the proposed SNS operations.

Proposals are pending on four major ecological research projects in the Walker Branch Watershed. Project Nos. F-1, F-2, and F-3 may also be affected by water vapor (refer to Table 4.1.8.3-2). Project Nos. F-1 and F-2 would be long-term projects (> 10 years). Project No. F-3 would be completed by FY 2001, but the subject of this project is a priority for long-term research in the future.

The potential effects of the proposed action on future research initiatives identified in the ORNL-ESD Strategic Plan cannot be fully determined at this time. However, given the potential for effects from nonrepresentative CO_2 and water vapor monitoring inputs to experiments, the effects described in Section 5.2.8.1.1 may apply to a number of these initiatives.

5.2.8.2.2 Common Ground Process and End Uses of ORR Land

The Common Ground process has resulted in citizen stakeholder recommendations to DOE on the future use of ORR land. Based on the presence of areas with High Significance biodiversity rankings, their recommendation for the proposed SNS site and adjacent land is a zoning category called Conservation Area Uses. These uses would include protection of the environment, environmental research sites, forestry, agricultural research, and passive recreation. Extensive development of the proposed site and related areas such as utility corridors and roads would be at variance with this zoning recommendation.

Recommendations for the end use of contaminated sites on the ORR have been developed and submitted to DOE by an Oak Ridge citizens' organization known as the End Use Working Group. These recommendations include the end use of contaminated sites in specific watersheds and a broader set of community land use guidelines. One of the group's principal concerns is the use of brownfield sites on the ORR to preserve undeveloped greenfield areas. The community guidelines recommend the siting of additional DOE facilities on brownfield sites rather than greenfield sites. The proposed SNS site at ORNL is a greenfield site.

The siting of the proposed SNS at ORNL would appear to be at variance with the recommendation of the End Use Working Group. However, construction of the proposed SNS would require a large 110-acre (45-ha) brownfield site with a configuration that could accommodate the proposed facility. This site would need to be available by the scheduled FY 2000 start date for construction of the proposed SNS. No brownfield site that meets these criteria is present on the ORR, thus necessitating use of a greenfield site for the proposed SNS.

5.2.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside the ORR and at one location on the ORR. Consequently, implementation of the proposed action on the SNS site at ORNL would have no reasonably discernible effects on the following specific land uses: University of Tennessee Arboretum, University of Tennessee Forest Experiment Station, Tennessee Valley Authority (TVA) recreation areas on Melton Hill Lake and Watts Bar Lake, and Clark Center Recreation Park.

The proposed SNS site is located within the Oak Ridge Wildlife Management Area on the ORR, and it is within a zone of the management area designated for public deer hunting. The proposed action would affect recreational hunting by slightly reducing the area of ORR land open to the public for deer hunting. The reduction would be approximately 110 acres (45 ha) of undeveloped land. This effect would be minimal because approximately 26,604 acres (10,735 ha) of ORR land would still be open to the public for recreational deer hunting.

The land areas within and adjacent to the proposed SNS site are part of the Oak Ridge NERP. The NERP would be affected by the proposed action. The potential effects of the proposed action within the NERP are discussed in the two preceding sections of the FEIS and Section 5.2.5.

5.2.8.4 Visual Resources

The proposed SNS would not be visible to the public from land-based vantage points outside the ORR and from most points on the reservation, including points along Bethel Valley and Bear Creek Roads. The proposed SNS facilities would come into view only along the upper reaches of Chestnut Ridge Road and the southwest access road to the proposed SNS site. During construction, these roads would be traveled by DOE and ORNL personnel, construction workers, and service providers. During operations, they would be traveled by DOE personnel, SNS employees, service providers, and visitors to the SNS facilities, including visiting scientists. Moreover, there are no established visual resources on the reservation that would include the proposed SNS. Therefore, implementation of the proposed action on the SNS site at ORNL would have minimal effects on visual resources.

5.2.9 HUMAN HEALTH

Construction and operation of the proposed SNS at ORNL could pose a potential risk of adverse effects on the health of workers and of the public living in the vicinity of the facility. Potential adverse effects include:

- Traffic-related fatalities and injuries to workers and the public.
- Occupational fatalities and injuries to workers.
- Exposure of workers and the public to radiation or radioactive materials.
- Exposure of workers and the public to toxic or hazardous materials.

This section evaluates the potential magnitude of these effects and the likelihood that they would occur during three phases or conditions:

- construction,
- normal operations, and
- accident conditions.

5.2.9.1 Construction

Construction of the 1-MW proposed SNS would require a total of 2,074 person-years of labor during the 7-year construction period and would reach a peak of 578 full-time workers during the fourth year of construction. At this stage of design, estimates of the number of workers that would be required to upgrade the facility for 2-MW or 4-MW operation are not available. Potential adverse effects on the health of workers and the public during construction activities include an increased risk of vehicle accidents due to increased traffic and the risk of occupational injuries or fatalities among construction workers. Construction workers, other ORNL site workers, and the public would not be exposed to toxic or radioactive materials as a result of construction activities because the preferred site for the proposed SNS at ORNL is not contaminated with such materials.

The increase in risk of disabling injuries or fatalities to the public and other ORNL workers due to construction workers commuting to the site can be estimated based on data provided in Section 5.2.10.1. The 9,690 workers now employed at ORNL make an estimated 7,810 daily round-trips as they enter and leave (0.806 round-trips/worker). During the peak year of construction, construction workers would add 466 round-trips (0.806 round-trips/worker $\times$ 578 workers), an increase of 6 percent.

It is assumed that the average round-trip distance traveled by construction workers is the same as that for other workers at ORNL. An increase of no more than 6 percent in injuries and fatalities from motor vehicle accidents would be expected during construction of the proposed SNS. It is also assumed that the average round-trip distance for an ORNL worker is 20 miles (32 km); the total of 417,911 daily round-trips by construction workers over the 7-year construction period (2,074 person-years $\times$ 250 work days/person-year $\times$ 0.806 daily round-trips/worker) would add 8,360,000 miles (13,400,000 km) of travel. Data available from the National Safety Council (http://www.nsc.org/lrs/statinfo/afp78.html) for 1996 indicate that 1.74×10^{-8} fatalities per vehicle mile and 1.05×10^{-6} disabling injuries per vehicle mile occurred on average in the United States. On the basis of these rates and the anticipated total mileage, less than one additional fatality (0.15) and nine additional disabling injuries could occur as the result of increased commuter traffic during the 7-year construction period of the proposed SNS. Although these impacts would be due to the addition of SNS construction workers to traffic flow, the injuries or fatalities could affect anyone operating a motor vehicle in the vicinity, including other ORNL workers and members of the public.

The potential risk of occupational injuries and fatalities to workers constructing the proposed SNS would be expected to be bounded by injury and fatality rates for general industrial construction. Data available from the National Safety Council for the years 1992 through 1996 (http://www.nsc.org/lrs/statinfo/afp48.htm) indicate that the fatality rate of construction workers has been relatively constant, averaging 15 to 16 deaths per 100,000 workers (0.00015 to 0.00016 fatalities per worker-year). For 1996 the risk of occupational fatality was 0.00015 per construction worker-year, and the risk of disabling injury was 0.053 per construction worker-year. On this basis, less than 1 fatality (0.000015 fatalities/worker-year × 2,074 worker-years = 0.31 fatalities) and 110 disabling injuries (0.053 disabling injuries/worker-year × 2,074 worker-years) could occur as the result of occupational accidents during construction of the proposed SNS.

The previous discussion is based on construction of the 1-MW proposed SNS facility. At this stage of design, estimates of the number of workers that would be required to upgrade the facility to 4-MW operation are not available. Because the amount of construction required for upgrade to 4 MW would be less than that required for construction of the original facility, injuries and fatalities for traffic-related and construction accidents for the 4-MW facility would be less than those for construction of the original facility regardless of where the SNS is located.

5.2.9.2 Normal Operations

During normal (accident-free) operations, a maximum of 375 workers would commute daily to the proposed SNS. This number of workers would represent an increase of approximately 4 percent in traffic due to the ORNL workforce and could be expected to increase the number of motor-vehicle-related disabling injuries and fatalities to workers and the public in the vicinity by this same percentage.

On the basis of national traffic accident rates (0.0174 fatalities per million vehicle-mile and 1.05 disabling injuries per million vehicle-mile) and the anticipated total mileage of 60 million miles (375 commuting workers × 20 miles/trip × 0.806 trips/day × 250 days/year × 40 years), one additional fatality and 63 additional disabling injuries could occur as the result of increased commuter traffic during the 40-year operational life of the proposed SNS.

Based on 1996 data available from the National Safety Council (http://www.nsc.org/lrs/statinfo/afp48.htm), 3.4 accident deaths and 3,400 disabling injuries would be expected each year in a work force of 100,000 in a standard industrial environment. Applying this data to the work force for the proposed SNS, less than 1 fatality (3.4 deaths annually/100,000 workers × 375 workers × 40 years = 0.5 deaths) and 510 disabling injuries (3,400 disabling injuries annually/100,000 workers × 375 workers × 40 years = 510 disabling injuries) could occur over the 40-year operational life of the proposed SNS.

The proposed SNS would generate and release direct radiation, radioactive materials, and toxic materials. Members of the public and workers at the proposed SNS and other adjacent facilities would be exposed to such radiation and emissions. The quantities and release rates of these materials would be the same as for the preferred alternative. The impact of the ORNL site-specific meteorology, distances to site boundaries, and population density and distribution are discussed in the following sections.

5.2.9.2.1 Radiation and Radioactive Emissions

This section assesses the potential effects of direct radiation and airborne emissions of radioactive materials from the proposed SNS based on the methods and dose-to-risk conversion factors discussed in Section 5.1.9.

Direct Radiation

Direct radiation is ionizing, penetrating radiation emitted from sources external to the human body. High levels of direct radiation would exist in the linac and beam tunnels, and very high levels would exist in the target area when the proton beam is on. These levels would subside rapidly in most areas once the beam is cut off; however, the mercury target itself and some target components would continue to emit radiation levels high enough to require that these components be handled remotely.

At the current stage of design, specific estimates of potential direct radiation exposures of workers or the public from the proposed SNS are not available. The Shielding Design Policy for the proposed SNS has been established to guide design by specifying maximum allowable radiation exposure rates for various areas inside and outside the SNS (ORNL 1997a). The policy is intended to ensure that facility design incorporates sufficient shielding to allow compliance with the requirements of 10 CFR Part 835, *Occupational Radiation Protection*, and DOE Order 5400.5, *Radiation Protection of the Public and the Environment for Operation of the SNS* at a proton beam power of 4 MW. The policy is based on consideration of dose limits and requirements for the use of personal dosimeters by members of the public in controlled areas, for nonradiological workers, and for radiological workers. This policy is also based on the length of time that each category of individual could be expected to occupy a given area.

Under this policy, the annual dose to members of the public, including site visitors, would not exceed 100 mrem outside the controlled area or 50 mrem inside the controlled area. The annual dose to workers who are not radiological workers would not exceed 100 mrem at any location from the proposed SNS operations. Radiological workers (workers who could receive an annual dose of more than 100 mrem during performance of their routine duties) could receive up to 5 rem annually under the regulations of 10 CFR Part 835. However, common practice at DOE facilities is to impose administrative controls that limit exposures to some fraction of the allowable limit.

Actual doses from direct radiation at the proposed SNS are expected to be much less than these limits, based on experience at other particle accelerators operated by DOE. These accelerators include electron, positron, proton, and heavy ion accelerators. These accelerators must address many of the same radiation protection issues as the proposed SNS. These issues include activation of air and accelerator components due to beam loss and high radiation levels from nuclear interactions in targets and target components. During the period 1994 through 1996, individual monitored workers at any DOE accelerator facility did not receive an annual dose in excess of 2 rem, and the average annual dose to monitored individuals at all DOE accelerator facilities ranged from 0.065 rem to 0.098 rem (DOE 1996f). These average annual doses include both external and internal exposures and are less than 2 percent of the 5-rem limit. These data indicate that doses to the public would also be far below the 100-mrem annual limit.

During the first full year of operation, approximately 250 people would work at the proposed SNS. This number would increase to 375 people when the second target is completed. Based on a risk factor for workers of 0.0004 LCF per person-rem, less than one excess LCF could be estimated among these workers if each worker received an annual dose of 0.098 rem each year of the 40-year life of the facility (0.4 excess LCF for 250 workforce and 0.6 excess LCF for 375 workforce).

Radioactive Emissions

Radioactivity would not be discharged from the proposed SNS to surface water under normal conditions of operation. LLLW and process waste would be collected and transported by tanker truck to existing waste processing facilities. As discussed in Section 5.2.11, the existing waste management systems at ORNL have sufficient capacity to accommodate the proposed SNS wastes. Effluents from treatment of the proposed SNS wastes would be released in accordance with existing permits for these facilities.

Radioactive emissions to the atmosphere from the proposed SNS would consist of releases from two stacks—the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack. The locations of these stacks are shown in Figure 3.2.1.5-1. Annual emissions from these systems are summarized in Table 3.2.3.5-1 for power levels of both 1 MW and 4 MW. A detailed list of radionuclide emissions used for dose calculations is provided in Table G-1 of Appendix G.

Doses to workers and members of the public due to exposures from routine operational releases of radionuclides from the SNS at ORNL are shown in Table 5.2.9.2.1-1. Based on the conservative assumptions and calculation methods discussed in Section 5.1.9, annual doses to workers and the public from airborne emissions from the SNS would be comparable to annual doses from existing ORNL airborne emissions. The estimated dose from all 1996 airborne emissions at ORNL to the maximally exposed off-site individual was 0.45 mrem, and estimated dose to the off-site population was 9.9 person-rem (ORNL, OR Y-12, and ETTP 1997). If it is assumed that the current ORNL maximally exposed individual and the proposed SNS maximally exposed individual would be in the same location, then SNS operations would increase the annual dose to the maximally exposed individual to 0.84 mrem for operations at 1 MW and to 2.0 mrem for operations at 4 MW. The limit for annual dose to the public from all airborne emissions from DOE facilities is 10 mrem (40 CFR Part 61), and DOE expects the facility to meet this limit. These doses would be 8 percent and 20 percent, respectively, of this limit for all exposure pathways for airborne emissions.

Dose at the ORNL boundary due to emissions from the Tunnel Confinement Exhaust is 0.008 mrem and dominated by radionuclides in activated concrete dust. The annual dose at the ORNL boundary due to emissions from the Target Building Exhaust is 0.39 mrem and is dominated by H-3 (54 percent) with smaller contributions from C-14, I-125, Hg-203, and

Table 5.2.9.2.1-1. Estimated annual radiological dose from proposed SNS normal emissions at ORNL.[a]

Receptor	1-MW Power Level		4-MW Power Level	
	Target Building[b]	Tunnel Confinement[c]	Target Building[b]	Tunnel Confinement[c]
Maximum Individuals (mrem)				
Off-site Public[d]	0.39	0.008	1.5	0.009
Uninvolved Workers[d]	0.31	0.20	1.2	0.30
Populations (person-rem)				
Off-site Public[e] (879,546 persons)	3.3	0.049	13	0.049
Uninvolved Workers[e] (271 persons)	0.006	0.001	0.023	0.002

[a] Doses shown include the contributions of inhalation, immersion, and "ground shine" for workers and the off-site public and ingestion for the off-site public.

[b] Target Building emissions include hot offgas exhaust, primary confinement exhaust, secondary confinement exhaust from the target building, and activated air from the beam dump buildings.

[c] Tunnel confinement emissions include activated air and concrete dust from the linac tunnel, high-energy beam transport (HEBT) tunnel(s), ring tunnel(s), and ring-to-target beam transport tunnel(s).

[d] The maximally exposed individuals are hypothetical receptors. The member of the public is assumed to occupy a position at the ORR boundary for 8,760 hr/yr and to produce their entire food supply at this location. The maximally exposed uninvolved worker is assumed to occupy a position within 1.2 miles (2 km) of the stack for 2,000 hr/yr.

[e] The off-site population consists of all individuals residing outside the ORR boundary within 50 miles (80 km) of the site and is assumed to be present for 8,760 hr/yr. The uninvolved worker population consists of all workers normally within 1.2 miles (2 km) of the facility. These workers are assumed to be present for 2,000 hr/yr.

Te-121. These radionuclides are listed in order of decreasing dose and account for 99 percent of the annual dose.

To estimate the total potential risk from the proposed SNS emissions of radioactive materials over the entire life of the facility, annual population dose is multiplied by the operating life of the facility and the dose-to-risk conversion factor of 0.0005 LCF/person-rem. For 40 years of operation at 1 MW, 0.07 excess LCF would be projected in the off-site population (3.3 person-rem/yr × 40 years × 0.0005 LCF/ person-rem = 0.07 LCF). For 40 years of operation at 4 MW, 0.3 LCF could be projected (13 person-rem/yr × 40 years × 0.0005 LCF/ person-rem = 0.3 LCF).

The proposed SNS would not operate at a single power level over its entire life, so the projected impact is between the two values indicated. After several years of operation at lower power levels, facilities would be upgraded to operate at 4 MW. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the projected number of excess LCFs would drop to 0.2. These projections are based on very conservative assumptions regarding pathway exposures and on the assumption that any exposure to radiation, no matter how small, involves some potential risk. Calculated excess

LCFs provide a quantified value of risk to compare alternative actions.

5.2.9.2.2. Toxic Material Emissions

The only toxic material that would be emitted from the proposed SNS during normal operations is elemental mercury vapor. Lead would be used for radiation shielding in the target areas and other areas of the proposed SNS, but it is not volatile at the temperatures to which it would be subjected. Methods used to estimate atmospheric concentrations of toxic material emissions are discussed in Section 5.1.9.

At the annualized mercury release rate of 0.0171 mg/sec and considering historical wind patterns at ORNL, the maximally exposed uninvolved worker (one who is outside and within 2,000 m or 6,500 ft of the SNS) would be exposed to a peak concentration of 3.3 × 10-6 mg/m^3 (1/300,000th of the OSHA limit) and to an 8-hr average concentration of 1.1 × 10-6 mg/m^3 (1/200,000th of the ACGIH limit). On this basis, toxic effects due to mercury exposure would not be expected among workers.

Using the same annual mercury release rate and historical wind patterns, the maximum airborne concentration of mercury at the ORNL boundary is estimated to be 8.7×10^{-9} mg/m^3. This is only 1/800,000th of the EPA RfC applicable to the general public residing in the vicinity of the proposed SNS site. On this basis, toxic effects due to mercury exposure would not be expected among the off-site population.

5.2.9.3 Accident Conditions

This section discusses the impacts on human health of accidents that could potentially occur during operation of the proposed SNS at ORNL. Methods used in the calculation of accident consequences are discussed in Section 5.1.9. Accident consequences are calculated based on the assumption that an accidental release has occurred; the probability that the consequences would actually appear depends on the probability that the accident actually occurs. Probabilities or frequencies of accidents are addressed in Appendix C.

5.2.9.3.1 Accident Scenarios

The accident scenarios and source terms for accidents that could potentially occur at the proposed SNS facility are the same for all alternative sites and are summarized in Table G-2 (refer to Appendix G). The details of these scenarios and source terms are provided in Appendix C. Table 3.2 defines the terminology used to describe the probability or likelihood that a given accident could occur.

5.2.9.3.2 Direct Radiation

The frequencies of occurrence and consequences of accidents involving exposure to direct radiation have not been specifically analyzed by DOE. DOE's Shielding Design Policy for the proposed SNS is such that for the worst-case design-basis accident, the dose to the maximum exposed individual in an uncontrolled area would be limited to 1 rem and for a worker in a controlled area would be limited to 25 rem. The risks of this category of accidents would be the same for all alternative sites.

5.2.9.3.3 Radioactive Materials Accidents

DOE has performed a hazard analysis of potential accidents at the proposed SNS facility; for those that could result in a release of radioactive material, it has estimated source terms. The DOE analysis is included as Appendix C. Accident scenarios, estimated frequencies of occurrence, and source terms are summarized in Table G-2 and are the same for all SNS alternative sites. The methods used to evaluate the consequences of these accidents are discussed in Section 5.1.9 and in more detail in Appendix G. Consequences of accidents vary by alternative due to site-specific weather patterns and population distributions.

Doses for these accidents, should they occur at the proposed SNS facility at ORNL, are listed in Table 5.2.9.3.3-1. Source terms listed in Table 5.2.9.3.3-1 are expressed in terms of percent of the inventory (mass or volume) of material released. With the exception of accident ID 16, source terms expressed in these terms are independent of power level; that is, the accident releases the same mass of the source materials, but at 4-MW operation, the mass has four times as much radioactivity as at 1-MW operation. For accident ID 16, this 4:1 ratio is not maintained; while the radioactivity per gram is still four times as much, the target boiling assumed to occur in the 4-MW accident releases more volume, so that the radioactivity released is greater than four times as much (refer to Exhibit F of Appendix C).

The quantities of radioactive materials that could be released in many of the accidents that could potentially occur at the proposed SNS are so small that the individual worker or member of the public would not be expected to receive a dose of more than 0.001 mrem. This is approximately 1/1,000th of the radiation exposure that the average person in the United States receives from natural background in a single day.

For accidents involving targets or target components, the beyond-design-basis mercury spill (ID 16) would have the greatest calculated doses. Based on the dose-to-risk conversion factor of 0.0005 LCF/person-rem, adverse health effects in the off-site population are estimated at 0.29 excess LCF for the 1-MW accident and 31 excess LCFs for the 4-MW accident. The probability of this accident is categorized as "beyond extremely unlikely" or less than 1/1,000,000 per year.

Two accidents involving the off-gas waste system could result in high consequences. Doses for these two accidents, an "anticipated" valve sequence error for the off-gas decay tank (ID 24) and an "extremely unlikely" failure of the decay tank itself (ID 31), are identical. For the accident at 1-MW operation, the population dose of 290 person-rem corresponds to 0.14 excess LCF. For the accident at 4-MW operation, the dose to the off-site population of 1,100 person-rem corresponds to 0.57 excess LCF. The scenario for ID 24 is "anticipated" due to an accident caused by a human error, but it takes no credit for possible mitigation factors such as administrative procedures that could require independent verification of valve sequences for the tank or a radiation-activated valve on the vent line. Either one would reduce the frequency of ID 24 to "unlikely."

5.2.9.3.4. Hazardous Materials Accidents

The analysis of accidents at the proposed SNS (Appendix C) classifies accidents involving nonradioactive materials as standard industrial accidents and does not estimate source terms for

Table 5.2.9.3.3-1. Radiological dose for SNS accident scenarios at ORNL.

				Maximum Individual (mrem)[a]				Population (person-rem)[a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
A. Accidents Involving Proposed SNS Target or Target Components											
2	Major Loss of Integrity of Hg Target Vessel or Piping (Appendix C, Section 3.3)	a) Unlikely	Percent Inventory: Mercury 0.142, Iodine 0.142	2.2	8.8	7.9	31.6	81.0	324.0	0.20	0.80
		b) Extremely Unlikely	Percent Inventory: Mercury 0.243, Iodine 100	9.5	38.0	19	76.0	360.0	1,440.0	0.47	1.88
8	Loss of Integrity in Target Component Cooling Loop (Appendix C, Section 3.9)	a) Anticipated	Bounded by annual release limits[d]	<10	<10	NA	NA	NA	NA	NA	NA
		b) Anticipated	Gases + Mist + 150 L of D_2O	0.33	1.32	0.62	2.48	6.1	24.4	0.006	.024
		c) Anticipated	18 L of D_2O	<0.001	<0.001	0.003	0.012	0.016	0.064	<0.001	<0.001
		d) Anticipated	Gases + Mist + 150 L of H_2O	0.20	0.80	0.54	2.16	0.91	3.64	0.004	0.016
16	Beyond-Design-Basis Hg Spill (Appendix C, Section 3.17)	a) Beyond Extremely Unlikely	1 MW Percent Inventory: Mercury 1.11, Iodine 100	16		57		570		1.4	
		b) Beyond Extremely Unlikely	4 MW Percent Inventory: Mercury 1.28, Iodine 100		1,600		1,800		62,000		46

Table 5.2.9.3.3-1. Radiological dose for SNS accident scenarios at ORNL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
	B. Accidents Involving Proposed SNS Waste Systems										
17	Hg Condenser Failure (Appendix C, Section 4.1.1)	Anticipated	13.7 g mercury	0.005	0.02	0.009	0.036	0.16	0.64	<0.001	<0.004
18	Hg Charcoal Absorber Failure [d] (Appendix C, Section 4.1.2)	Unlikely	14.8 g mercury	<0.001	<0.001	0.006	0.024	0.031	0.124	<0.001	<0.001
19	He Circulator Failure (Appendix C, Section 4.2.1)	Anticipated	1 day of tritium production	<0.001	<0.001	<0.001	<0.001	0.003	0.012	<0.001	<0.001
20	Oxidation of Getter Bed (Appendix C, Section 4.2.2)	Unlikely	1 day of tritium production	<0.001	<0.001	<0.001	<0.001	0.003	0.012	<0.001	<0.001
21	Combustion of Getter Bed (Appendix C, Section 4.3.1)	Extremely Unlikely	1 year of tritium production, 200 g depleted uranium	2.9	11.6	2.0	8.0	120	480	0.050	0.20
22	Failure of Cryogenic Charcoal Absorber [e] (Appendix C, Section 4.4.1)	Unlikely	1 day of xenon production	0.089	0.356	0.038	0.152	3.0	12.0	<0.001	<0.001
23	Valve Sequence Error in Tritium Removal System (Appendix C, Section 4.5.1)	Unlikely	1 year of tritium production	2.8	11.2	1.9	7.6	110	440	0.048	0.192
24	Valve Sequence Error in Offgas Decay System (Appendix C, Section 4.5.2)	Anticipated	7 days of xenon accumulation (1 decay tank)	7.3	29.2	4.8	19.2	290	1,160	0.12	0.48

Table 5.2.9.3.3-1. Radiological dose for SNS accident scenarios at ORNL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
B. Accidents Involving Proposed SNS Waste Systems (continued)											
25	Spill During Filling Of Tanker Truck For LLLW Storage Tanks (Appendix C, Section 4.5.3)	Anticipated	0.00005% of contents of LLLW tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Spray During Filling Of Tanker Truck For LLLW (Appendix C, Section 4.5.4)	Anticipated	1.9 ml of LLLW	0.03	0.12	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Spill During Filling Of Tanker Truck For Process Waste Storage Tanks (Appendix C, Section 4.5.5)	Anticipated	51,100 L process waste to surface water + 57 L to atmosphere	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
28	Spray During Filling Of Tanker Truck For Process Waste (Appendix C, Section 4.5.6)	Anticipated	28.4 L of process waste	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
29	Offgas Treatment Pipe Break (Appendix C, Section 4.6.1)	Unlikely	24 hrs of xenon production	0.96	3.84	0.28	1.12	13	52	0.009	0.036
30	Offgas Compressor Failure (Appendix C, Section 4.6.2)	Unlikely	1 hr of xenon production	0.14	0.56	0.35	1.4	2.0	4.0	0.001	0.004

Table 5.2.9.3.3-1. Radiological dose for SNS accident scenarios at ORNL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
B. Accidents Involving Proposed SNS Waste Systems (continued)											
31	Off-gas Decay Tank Failure (Appendix C, Section 4.6.3)	Extremely Unlikely	7 days of xenon accumulation	7.3	29.2	4.8	19.2	290	1,160	0.12	0.48
32	Offgas Charcoal Filter Failure (Appendix C, Section 4.6.4)	Unlikely	7 days of iodine production	0.048	0.192	0.042	0.168	0.30	1.2	<0.001	<0.001
33	LLLW System Piping Failure (Appendix C, Section 4.6.5)	Unlikely	0.00005% of contents of LLLW tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
34	LLLW Storage Tank Failure (Appendix C, Section 4.6.6)	Extremely Unlikely	0.00005% of contents of LLLW tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
37	Process Waste Storage Tank Failure (Appendix C, Section 4.6.9)	Extremely Unlikely	57 L to atmosphere	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 5.2.9.3.3-1. Radiological dose for SNS accident scenarios at ORNL – (continued).

[a] Unless otherwise indicated, radiological doses are based on radiological source terms for a 1-MW power level and would be four times greater if the facility is operating at 4 MW. These doses are total EDEs and include dose from inhalation and immersion. "Off-site" means outside the site boundary rather than outside the proposed SNS facility boundary. Individual receptors are hypothetical and do not correspond to any actual person. Population receptors are based on the actual number of people residing outside the site boundary and within 50 miles (80 km) of the facility and the number of site workers normally within 1.2 miles (2 km) of the facility and not involved in facility operation.

[b] See Table 5.2.9-2 for the numerical ranges associated with accident frequencies categories.

[c] Source terms are expressed in units that are independent of power level. Except for beyond-design-basis accidents (IDs 16a, 16b), the radioactivity released in accidents at 4 MW is four times that released at 1 MW.

[d] Installation of sulfur-impregnated charcoal filters is being considered to serve as a "polishing filter" for the mercury condenser (refer to Event 17).

[e] Cryogenic charcoal absorbers are being considered as an alternative to the offgas compressor, decay storage tanks, and ambient temperature charcoal filters (refer to Events 24, 30, 31, and 32).

NA - Not available.

these accidents. Four accident scenarios involve the release of radioactive mercury: IDs 2a, 2b, 16a, and 16b. Each of these accidents involves relatively high rates of mercury release during the first few minutes of the accident followed by much lower rates of release. The second and third stages of these accidents are conservatively assumed to last from 7 to 30 days. In reality, administrative and emergency response actions would more probably terminate the release in a shorter time period.

Three of these accidents could result in workers being exposed to airborne concentrations of mercury in excess of the OSHA ceiling concentration of 0.1 mg/m^3. The peak concentrations for these accidents are 0.65 mg/m^3 for ID 2b, 0.28 mg/m^3 for ID 16a, and 7.9 mg/m^3 for ID 16b. In all cases, concentrations would fall below the ceiling concentration within minutes after the beginning of the release. OSHA does not specify a time-weighted-average or peak concentration above the ceiling for mercury; however, the ACGIH recommended concentration limit of 0.05 mg/m^3 is an 8-hr averaged concentration.
For only a few minutes at the start of the accident, mercury concentrations at or beyond the site boundary might exceed the temporary emergency exposure limit (TEEL)-1 (0.075 mg/m^3) but would not exceed TEEL-2 (0.10 mg/m^3) described in Appendix G.5.2. Individuals at the boundary at the precise passage of the initial emission might perceive an odor but would not experience or develop irreversible health effects or symptoms that could impair the ability to take protective action.

During the second and third phases of the release, maximum mercury concentrations are two to three orders of magnitude below TEEL-0 of 0.05 mg/m^3. Since maximum concentrations at the ORNL boundary are approximately one-half the maximum concentrations in areas that could be occupied by workers, it is likely that any observable health effects would not occur among workers or the public should any of these accidents occur.

Accident ID 2b is “extremely unlikely,” and IDs 16a and 16b are “beyond extremely unlikely.” Accordingly, the risk of adverse health effects due to accidental releases of toxic materials from the proposed SNS is very low.

5.2.10 SUPPORT FACILITIES AND INFRASTRUCTURE

This section summarizes the facilities and infrastructure effects to ORNL transportation and utility systems resulting from construction and operation of the proposed SNS project.

5.2.10.1 Transportation

As described in Section 3.2.5, Alternative Sites, construction of the proposed SNS-related infrastructure and support systems would occur at ORNL, located in the vicinity of the City of Oak Ridge, Tennessee. The site would be accessible by numerous state and federal highways and would be serviced on the north by Bear Creek Road and on the south by Bethel Valley Road.

As noted in Section 4.1.10.1, the transportation analysis for the Advanced Neutron Source (ANS) (Blasing et al. 1992) included a detailed transportation analysis that is directly relevant to the proposed SNS action. Evaluated roadways included Bethel Valley Road, State Road (SR)-95, and SR-62.

Construction employee and vehicle activity would increase during the first years of construction of the proposed SNS, peaking in the year 2002, and would decrease significantly during the last year (2004) of construction. The estimated total of 578 construction-related employees in the peak construction year (2002), is expected to add approximately 466 daily round-trips and 10 material/service trucks to the total ORNL site traffic of 6,771 round-trips. This represents a 7 percent increase.

Traffic impacts could include changes in existing vehicle flow, speed, and maneuverability and general congestion because of new vehicles traveling the roadways as a result of construction of the proposed SNS.

Operation of the proposed SNS project would result in an additional 250 resident/visiting scientists by the year 2006, plus another 125 employees during future facility upgrades, such as a second target station. If fully upgraded to the 4-MW power level, 375 employees and 3 service trucks per day would result in approximately 305 daily round-trips, or a 5 percent increase. Traffic effects would occur from the increased volume created by the proposed SNS. Traffic effects could include changes in existing vehicle flow, speed, and maneuverability and general congestion as a result of the comparatively high amount of new vehicles traveling the roadways.

Table 5.2.10.1-1 compares the No-Action Alternative with the proposed action at the Oak Ridge site. The table provides the percent increase in traffic resulting from the proposed SNS during construction and operation, as compared to the No-Action Alternative. The effect on traffic on the ORR is expected to be minimal. These potential effects could be reduced by having craft and non-craft workers report to work at different times, thus reducing the adverse effects on traffic flow during rush hours. Additionally, this analysis assumed there would be no transferring of personnel from within ORNL. If some of the workers were previously working at ORNL, the impact on traffic would be reduced.

5.2.10.2 Utilities

Effects from meeting the proposed SNS utility requirements would be limited to extending the existing site services to the Chestnut Ridge area. Substantial upgrades or construction of new facilities would not be required. Modifications to existing electrical, steam, natural gas, water, and sewage treatment are discussed in the subsections below.

5.2.10.2.1 Electrical Service

As described in Section 4.1.10.2.1, two existing 161-kV transmission lines terminate into a substation approximately 6,000 ft (1800 m) west of the proposed site. TVA has adequate capacity to supply the 90 MW of electrical power required for the 4-MW SNS via the existing 161-kV transmission line (Schubert 1997).

A new 161-kV transmission line would be constructed from the existing transmission line, approximately 3,000 ft (914 m) west of the proposed site, to a new substation to be located on the SNS site. Construction effects would be limited to minor excavation for the transmission line poles, and a minor amount of clearing and excavation for electrical equipment pads at the proposed SNS. No upgrades to the existing site service are expected. Environmental effects from constructing a new transmission line to the proposed SNS are expected to be negligible.

Table 5.2.10.1-1. ORNL traffic increases compared to No-Action Alternative.

	Baseline/ No-Action	(Peak Year) SNS Construction	(4-MW) SNS Operation
Passenger vehicle trips[a]/day	6295	466	302
Material transport trucks/day	0	7	0
Service trucks/day	0	3	3
Total (% increase)	0 (0%)	476 (7%)	305 (5%)

[a]Based on 7810 ORNL employees (Blasing et al. 1992)

5.2.10.2.2 Steam

The current design calls for steam to be produced at the proposed SNS facility using natural-gas-fired boilers (refer to Section 5.2.10.2.3). However, steam requirements during operation of the proposed SNS could be satisfied by the existing on-site steam service. ORNL has the capacity to service the proposed SNS without upgrading the steam plant. The available capacity of the existing on-site steam is sufficient to accommodate any demand for steam that the proposed SNS may require. As described in Section 4.1.10.2.2, the closest tie in point is an existing 8-in. (20.3-cm) steam line located between the 6000 and 7000 Areas. To service the proposed SNS facility, this line would be extended approximately 1.5 to 2 miles (2.4 to 3.2 km) to the proposed SNS facility. Environmental effects from constructing a new steam line to the proposed SNS are expected to be negligible. A final decision on the steam supply would be made during Title 1 design and would take into account environmental effects as well as cost.

5.2.10.2.3 Natural Gas

Natural gas would provide energy for operational functions in the proposed SNS, such as fuel for the boilers and localized unit heaters in the facility heating system. East Tennessee Natural Gas (ETNG) has indicated that the current 22-in. (55.9-cm) gas main has adequate capacity for proposed SNS operational requirements.

As described in Section 4.1.10.2.3, the distribution header is approximately 1 mile (1.6 km) from the proposed SNS site. Based on current design plans, approximately 5,000 ft (1,524 m) of new natural gas pipeline would be required to service the proposed SNS facility. Current plans would route the pipeline extension along Chestnut Ridge Road, the main access road, to the proposed SNS facility. This would encroach on 0.12 acres of wetlands (see Section 5.2.5.2).

5.2.10.2.4 Water Service

The proposed SNS would require water supplies for the following systems: tower water cooling, deionized cooling, chilled water, building heating, process water, potable water, demineralized water, fire suppression, and target moderators. Based on the operational needs of the proposed SNS facility, ORNL's water distribution system is considered adequate and has available capacity to serve the proposed SNS facility.

As described in Section 4.1.10.2.4, the existing water service is located adjacent to the southern and eastern edge of the proposed SNS site. However, there are no water lines on-site. Environmental effects from constructing a new water line to the proposed SNS are expected to be negligible.

5.2.10.2.5 Sanitary Waste Treatment

The existing sewage treatment plant (STP) at ORNL has adequate capacity for demands of the proposed SNS. Approximately 100,000 gpd (378,540 lpd) of sewage treatment capacity is available at the STP. Operation of the proposed SNS would generate approximately 12,500 gpd (47,318 lpd) at the 1-MW facility and 18,150 gpd (68,705 lpd) at the 4-MW facility.

The proposed SNS sewage system would tie into the existing sewage system at a point west of the 6000 Area and approximately 1 mile (1.6 km) from the site. This is a gravity system with an 8-in. (20.3-cm) line. Environmental effects from constructing a new sewer line to the proposed SNS are expected to be negligible.

5.2.11 WASTE MANAGEMENT

All of the wastes generated during construction and operation of the proposed SNS would be transferred to ORNL for processing. The existing waste management systems, either at ORNL or at other facilities on the ORR, have sufficient capacity to accommodate the proposed SNS waste streams. Additionally, standard DOE practice has been to dispose of hazardous waste at off-site, DOE-approved licensed commercial facilities. Therefore, DOE anticipates only minimal effects on the environment from waste management activities associated with the SNS..

The proposed SNS facility construction/ operations projection of waste streams includes the following: hazardous waste, low-level waste (LLW), mixed waste, and sanitary/industrial waste, as listed in Table 3.2.3.7. A summary of existing waste management facilities located at ORNL, along with facility design and/or permitted capacities and remaining capacities available, can be found in Table 5.2.11-1. The projected waste stream forecast for ORNL's individual operations, proposed SNS operations at 4 MW, and the projected combination of the aforementioned wastes, as well as potential effects, are also included in Table 5.2.11-1. Forecasts are projected from 1998 to 2040, unless otherwise noted, and they are based on estimates received from waste management facility contacts and waste management documentation.

The current waste management activities at ORR include the treatment and storage of LLMW on site, and the treatment and disposal of LLW on site. Under the preferred alternatives in the Waste Management PEIS (DOE 1997a), ORR is one of six candidate sites for regional disposal of LLW and LLMW. DOE will choose two or three regional disposal sites from the six candidate sites. These sites are those at which DOE already has established LLW disposal operations and has large waste volumes for disposal. The ORR, along with the other sites, would have more than adequate capacity for the amounts of LLW that DOE will need to dispose. Based on DOE's analysis in the Waste Management PEIS, it is anticipated that the ORR has sufficient capacity to meet the LLW streams for the proposed SNS.

The Tennessee Department of Environment and Conservation (TDEC) may, in the future, regulate the management of radioactive products and wastes produced by accelerator facilities. If the ORNL site is selected for construction of the SNS, DOE would consult with the State of Tennessee and implement procedures to comply with all applicable regulations.

As shown in Table 5.2.11-1, ORNL does have the capability to store hazardous wastes; however, there are no hazardous waste treatment or disposal facilities at ORNL. DOE is phasing out the use of on-site hazardous waste [Resource Conservation and Recovery Act (RCRA)-permitted] storage facilities. Hazardous wastes will be collected and transferred to facilities at East Tennessee Technology Park (ETTP) or DOE-approved licensed commercial facilities. Oil acceptable for off-site recycling is accumulated on-site prior to transporting to an off-site facility (ESWMO 1995).

ORNL's solid LLW that meets GTS Duratek WAC is shipped directly to them for three volume reduction treatments including incineration, compaction, and smelting. LLW that cannot be sent to GTS Duratek is grouted at Solid Waste Storage Area (SWSA) 6, temporarily stored, and then transported to an off-site, DOE-approved licensed commercial disposal facility.

Presently, no facilities specifically designed for the disposal of mixed wastes are located at ORNL. Mixed wastes are temporarily stored on the ORR then transported to an off-site, DOE-approved licensed commercial disposal facility. Liquid mixed wastes that meet the WAC of the LLLW treatment facility or the process waste treatment facility can be treated at ORNL.

ORNL has a waste certification process in place to assure that wastes meet the WACs for LLW disposal. However, because of the uncertainty of the composition of LLW and mixed wastes that may be generated from operation of the SNS, the waste may not meet the current WAC for waste management facilities at ORNL. DOE would take action to assure the proper disposition of these wastes. For example, pretreatment of the wastes may assure they meet the WAC. DOE may be able to amend the license at current waste disposal facilities to allow acceptance of wastes from the SNS.

Solid sanitary/industrial wastes from ORNL are disposed of at Sanitary Landfill II, Industrial Landfill V, and Construction Disposal Landfill VI, located on Chestnut Ridge. ORNL solid sanitary waste projections indicate that a total of 7,645 m^3/yr of solid sanitary/industrial and construction/demolition wastes will be generated for the next 40 years. As listed in Table 3.2.3.7-1, the proposed SNS operations would add an additional 1,349 m^3/yr over the next 40 years to the ORNL solid sanitary/ industrial waste stream. Wastes must meet appropriate WAC before being transported for disposal (ESWMO 1995; DeVore 1998d).

Soil, construction, and sanitary wastes would be generated during the construction phase of the proposed SNS facility. Excavated soil and rock would be utilized, when applicable, for backfill, erosion control, or other environmental purposes. Construction debris would be sent to a Class IV landfill. Liquid sanitary wastes would be transported to the site sanitary wastewater treatment plant for disposal, and solid sanitary wastes would be sent to a sanitary landfill (ORNL 1997b).

To minimize the production of waste streams from the proposed SNS facility and to comply with the Pollution Prevention Act of 1990, along with other federal pollution prevention

Table 5.2.11-1. ORNL waste management facility description and capacities.

Waste Disposition	Waste Type and Facility	Total Design Capacity for ORNL Site	ORNL Waste Projections for 1998-2040	Total Remaining Capacity for ORNL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998-2040	Potential Effect of Waste Management on the Environment
HAZARDOUS WASTE						
STORAGE	Drummed Liquid and Solids 7507, 7651, 7652, 7653	139 m³	160 m^3/yr	No long-term storage	Hazardous Liquid 40 m^3/yr	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved, licensed commercial facilities.
LOW-LEVEL WASTE						
TREATMENT	Liquid a) LLLW Evaporator Facility b) Process Waste Treatment Plant (PWTP) c) Nonradiological Wastewater Treatment Plant	a) LLW Evaporator 2.63E06 gal/yr capacity b) PWTP - 350 gpm c) 760 gpm	a) LLW Evaporator- 500,000 gal/yr b) Process waste 140 gpm (0.74E08 gal/yr) c) 320 gpm (1.68E08 gal/yr)	a) LLW Evaporator- 2.13E06 gal/yr b) Process wastes - 210 gpm (1.1E08 gal/yr) c) 440 gpm (2.3E08 gal/yr)	a) LLW Evaporator 175,600 gal/yr b) 4.15E06 gal/yr potentially LLW c) 4.3E06 gal/yr	a) No effect anticipated. b) No effect anticipated. c) No effect anticipated.
	Solid None					
STORAGE	Liquid None					
	Solid Buildings 7823B, 7823C, 7823E, 7827, 7878A	NA	Solid 2,520 m³/yr	Limited	Solid 1,026 m³/yr	Limited storage available. Long-term storage is not necessary. DOE has contracts in place to dispose of LLW at off-site, DOE-approved licensed commercial facilities.

Table 5.2.11-1. ORNL waste management facility description and capacities (continued).

Waste Disposition	Waste Type and Facility	Total Design Capacity for ORNL Site	ORNL Waste Projections for 1998-2040	Total Remaining Capacity for ORNL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998-2040	Potential Effect of Waste Management on the Environment
MIXED WASTE						
STORAGE	Solid/ Liquids 7654, 7507W, 7830a, 7823	Maximum storage is 300 drums.	Liquid 55 drums/yr Solid 45 drums/yr	NA	Liquid 50 drums/yr Solid 35 drums/yr	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved, licensed commercial facilities.
SANITARY WASTE						
TREATMENT	Liquid Waste Water Treatment Facility	300,000 gpd	240,000 gpd	60,000 gpd	18,000 gpd	No effect anticipated.
	Solid None					
DISPOSAL	Solid ORR Landfills	1.45E6 m³	7,645 m³/yr	1.09E6 m³	1,350 m³/yr	No effect anticipated.

NA - Not applicable.
Sources: Martin Marietta Energy Systems, Inc. 1994; Parrott et al. 1991; DeVore 1998a; 1998b; 1998c; 1998d; 1998e; 1998f; and 1998g.

regulations, the SNS conceptional design team developed the *NSNS Waste Minimization and Pollution Prevention Plan NSNS/97-5*. This written plan includes use of the Pollution Prevention Electronic Design Guideline (P2-Edge) software database. The P2-Edge software allows for assessment and identification of pollution prevention opportunities, evaluation of their cost, and selection of appropriate opportunities for implementation. An example of categories and considerations included in the P2-Edge software package can be found in Attachment 1 of the *NSNS Waste Minimization and Pollution Prevention Plan* (ORNL 1997a, LMES 1997).

5.3 LOS ALAMOS NATIONAL LABORATORY

This section describes the potential environmental effects or changes that would be expected to occur at LANL if the proposed action were to be implemented. Included in the discussion of this section are effects on the physical environment; ecological and biological resources; the existing social and demographic environment; cultural, land, and infrastructure resources; and human health.

5.3.1 GEOLOGY AND SOILS

Effects on geology and soils from construction and operation of the SNS on the proposed LANL site are described in this section.

5.3.1.1 Site Stability

The proposed SNS site at LANL is situated on a high mesa with a thin, unsaturated soil horizon overlying competent bedrock. Rockfalls from steep canyon ledges could be a potential problem if the proposed SNS is located near the edge of the mesa. However, the proposed setback from the mesa rim is sufficient to ensure that rockfalls or landslides are not a problem. Because of the nature of the soils and bedrock at this proposed site, neither soil liquefaction nor subsidence is considered likely. Construction and operation of the proposed SNS at Technical Area (TA)-70 would not be affected by site stability problems.

5.3.1.2 Seismic Risk

A LANL seismic hazards study indicates that the Pajarito fault system provides the greatest potential seismic risk with an estimated maximum earthquake magnitude of about seven. The PGAs for an earthquake at eight technical areas within LANL (not including TA-70) were calculated, and the maximum results among those areas were 0.15 gravity for a 500-year return period; 0.22 gravity for a 1,000-year return period; 0.31 gravity for a 2,000-year return period; and 0.57 gravity for a 10,000-year return period. Proximity to the three main faults of the Pajarito system increases the potential for higher ground acceleration during earthquakes (other factors being equal). While a site-specific seismicity study has not been conducted for TA-70, it is the location within the LANL reservation farthest from the surface expression of documented faults. PGA estimates for the proposed SNS location (TA-70) would be less than the maximum predictions for the other technical areas.

Components of the proposed SNS facility would be built at LANL to the DOE Standard 1020-94 (DOE 1996a) and would be capable of withstanding maximum horizontal ground accelerations in the range of 0.10 to 0.14 for a 500-year return period; 0.14 to 0.19 for a 1,000 year-return period, 0.17 to 0.25 for a 2,000-year return period; and 0.31 to 0.43 for a 10,000-year return period. The beam for the proposed SNS would be designed to immediately shut down in the event of an earthquake. Predictable seismicity for the TA-70 site would have no effect on the construction, operation, or retirement of the proposed SNS.

5.3.1.3 Soils

Excavation required for construction of the proposed SNS would disturb the native soils. Excavated soils would be stockpiled according to soil types and horizon. If the excavated soils possess the proper characteristics, they would be used to construct the shielding berm. Otherwise the soils would be placed in the spoils area (refer to Section 3.2.5.3). Top soil removed during excavation would be used for grading and landscaping of the site at the finish of construction.

Construction of the SNS would require removal grading of the site and removal of vegetative cover. As a result the potential exists for soil erosion and stream siltation especially during periodic storm events. Best management practices would be followed to minimize the impacts of erosion during construction activities. Section 3.2.2.3, Site Preparation, discusses the elements (retention basin, silt fences, temporary storm water drainages, etc.) that would follow an erosion control.

Although limited borrow materials are available within LANL, the Los Alamos County Landfill could supply additional soil for the berm. The material use for the proposed SNS would not affect the local supply for other uses.

Operation of the proposed SNS at LANL would activate soils adjacent to the linac tunnel (refer to Section 5.2.1.3). Site-specific calculations of nuclide concentrations and transport potential have not been performed for LANL. In general, however, groundwater at LANL is not very susceptible to contamination for two reasons. Soils and bedrock aquifers in the LANL region are derived from volcanic materials that exhibit a mineralogical composition that retards nuclide transport. The depth to the main bedrock aquifer is much greater than at ORNL (refer to Section 5.3.2.3). This combination of factors indicates that potential exposure effects would be the same or less than those at ORNL, which are predicted to be minimal.

No prime or unique farmlands are present on or in the vicinity of the proposed SNS site at LANL. As a result, the proposed action would have no effects on prime or unique farmlands.

5.3.2 WATER RESOURCES

The effects on water resources from construction and operation of the proposed SNS on the Pajarito Mesa site in TA-70 at LANL are described in the following sections. Best management practices would be employed to minimize any effects on surface water due to erosion and siltation during construction (see Section 5.2.1.3).

5.3.2.1 Surface Water

No surface water would be used to support construction or operation of the proposed SNS; therefore, there would be no effects on surface water supplies.

Conventional cooling tower blowdown for the proposed SNS would be released into surface drainages at TA-70. Continuous releases would occur at a rate of 250 gpm (946 lpm) for a 2-MW facility and 350 gpm (1,325 lpm) for a 4-MW facility. Surface water drainages in this area exhibit only intermittent flow. Flow volume attributable to blowdown would range between 0.36 to 0.50 mgpd (1.4 to 1.9 million lpd). The nearest perennial stream is the Rio Grande River approximately 1 to 2 miles (1.6 to 3.2 km) away. A significant portion, if not all, of the cooling tower blowdown would be dispersed by infiltration and evapotranspiration before it would reach the Rio Grande.

At the site, cooling tower blowdown would be temporarily held in a retention basin before release to the surface drainages. At the conceptual design stage, the size of the retention basin required is estimated at approximately 2 acres (0.81 ha). This basin would be designed to allow sufficient residence time for the discharge to cool to ambient temperatures. If necessary, active cooling systems such as recirculating fountains would be employed.

Polyphosphonates for antiscaling and ozone as a biocide would be used in the cooling towers. Discharge from the towers would be regulated to contain about four times the dissolved solids content of potable water (i.e., 1,000 to 1,200 mmhos conductivity). Contributions of solids or chemical agents are not anticipated to significantly effect the stream. Releases from the basin would be regulated under an NPDES permit that defines water quality parameters.

Effects on surface waters at TA-70 would result in sustained flow that is currently intermittent, thereby providing additional recharge to the groundwater and supporting limited flora and fauna in the drainage channels. It is not expected that the amount of infiltration from the limited discharge would impact perched water tables at depth or the occurrence of springs along the canyon walls.

5.3.2.2 Flood Potential and Floodplain Activities

The proposed SNS site at LANL does not lie within a floodplain or designated flood fringe area. Therefore, no flood potential exists. Seasonal storm events may cause localized flooding along the Pajarito Plateau and portions of the proposed SNS site when man-made storm drains and natural drainage exceed capacity. This result would be infrequent and temporary.

5.3.2.3 Groundwater

The main aquifer beneath LANL is the primary source of water for LANL and surrounding communities. Demands ranging from 800 to 1,600 gpm (3,028 lpm to 6,057 lpm) would be required to support the proposed SNS facility that may be upgraded from 1 MW to 4 MW. If, for example, one-half of the maximum water usage for a 4-MW facility would be the continuous daily demand for facility operations, then production from the main aquifer must increase by more than 25 percent. Sustained pumping at this magnitude could create a cone of depression that would lower water levels in nearby wells and ultimately affect the long-term productivity from the main aquifer (if withdrawal rates exceed recharge). Historic water level measurements in the main aquifer wells in the LANL region have indicated water level declines due to pumping and natural discharges exceeding recharge and inflow (DOE-AL, 1998). However, the drawdown is not considered to be a major depletion. Mitigation measures to reduce the drawdown of the aquifer, including the possible construction of a dry cooling tower to recycle process water used at the site, can be undertaken if LANL is selected for site construction. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4). However, based on the aforementioned historic studies that indicate water declines, some decline in the groundwater level from SNS operations may be inevitable, although the decline is not expected to impact the available municipal water supply. Future water demands of the proposed SNS would be in direct competition with future growth demands from commercial and residential users. Approximately half of the water required for the cooling towers would be released to the atmosphere, mostly in the form of water vapor. The other half, approximately 250 to 350 gpm, would be released as cooling tower blowdown to the retention basin. The rate at which the water would be released from the retention basin at the discharge point has not been determined; however, it would likely be less than 250 gpm. The discharge rate from the retention basin could be controlled to prevent large-scale surface water runoff during storm events. Accordingly, DOE believes that the water would infiltrate the ground before reaching the Rio Grande. If the LANL site is selected in the Record of Decision (ROD) for construction of the SNS, DOE would implement appropriate treatment, if necessary, to assure that all water discharge meets the requirements of the New Mexico Cold Water Fishery Standards.

Operation of the proposed SNS would affect the soil adjacent to the linac tunnel. This soil would act as a radiological source available for leaching and transport of nuclides via the groundwater system. Calculations for LANL have not been performed; however, characteristics of the groundwater system at LANL would make this site less susceptible than ORNL to effects on the groundwater from radionuclide contamination. The vadose zone is about 820 ft (250 m) thick at LANL, providing a much longer pathway for nuclides to reach the main aquifer. In addition, the vertical migration rate at LANL would be less due to reduced groundwater infiltration (approximately 5 cm/yr compared to 38 cm/yr at ORNL). The additional time would allow for greater radioactive decay and would result in less nuclide concentrations in the groundwater. Relative to ORNL (which has been shown to have minimal potential for concern), it is less likely that these activation products would be transported to off-site receptors at levels of concern. Effects causing groundwater contamination are considered minimal for LANL.

5.3.3 CLIMATOLOGY AND AIR QUALITY

Effects on the climate and air quality from construction and operation of the proposed SNS in TA-70 at LANL are described in the following sections.

5.3.3.1 Climatology

Construction and operation of the proposed SNS would not affect regional or localized climates within the LANL area.

5.3.3.2 Air Quality

Impacts on nonradiological air quality are presented in this section. Airborne radiological releases are evaluated under human health impacts (Section 5.3.9). Construction activities would create temporary effects in regard to particulate matter (PM_{10}) measurements during the construction phase of the project. These effects would be greatest during early clearing and excavation efforts but would decrease within a relatively short time period. While no formal estimates of suspended particulate matter have been prepared, this level is predicted to be minimal when weighted over the usual 24-hr averaging period. Moreover, the proposed SNS site is located several miles from residential inhabitants in a remote section of LANL.

The primary nonradiological airborne release during operations at the proposed SNS would be combustion products from the use of natural gas. Currently, natural gas is not available at TA-70; pipeline construction would be necessary to extend service into this area. The primary nonradiological airborne release during operations at the proposed SNS would be combustion products from the use of natural gas. Peak usage of natural gas would be during the winter months at an approximate rate of 1,447 lb/hr (4-MW scenario). Emission rates related to the maximum period of natural gas usage are listed in Table 5.2.3.2-1.

Ambient effects from natural gas usage can be projected with the Screen 3 model as in Section 5.2.3.2. However, since this location is relatively flat (unlike the Oak Ridge location), zero terrain height is used. The results of this modeling are shown in Table 5.3.3.2-1. Adding maximum background concentrations to maximum projected effects from the proposed SNS sources (a very conservative procedure since the two do not occur at the same location or time) does not provide any violations of the NAAQS.

5.3.4 NOISE

Construction and operation of the proposed SNS at LANL would slightly elevate ambient noise levels. Sensitive receptors (except for native wildlife) are not present at this remote location. Any noise effects on wildlife would be temporary; habitualized wildlife behavior

Table 5.3.3.2-1. Impact of natural gas combustion at the proposed SNS.

NAAQS Compound	Period[a]	Estimate (μg/m³) at 984 ft (300 m)	Maximum Concentration[b]	Assumed Background (μg/m³) (Table 4.2.3.3-1)	Background + 300-m Location (μg/m³)	NAAQS Limits (μg/m³)
Sulfur dioxide	Annual[c]	0.03	0.05	7.4	7.4	80
(SO_2)	24-hr	0.30	0.60	26.6	26.9	365
	3-hr	0.70	1.40	108.9	109.6	1,300
Carbon monoxide	8-hr	21	40	2,672	2,693	10,000
(CO)	1-hr	30	57	8,365	8,395	40,000
Nitrogen dioxide (NO_2)[d]	Annual[c]	5.0	9.0	5.7	10.7	100
Particulate	Annual[c]	0.60	1.10	9.0	9.6	50
(PM_{10})	24-hr	6.80	13.30	29.0	35.8	150

[a] Factors used to convert from 1-hr averages to long periods taken from EPA 1977.
[b] Concentration at 984-ft (300-m) estimated boundary and maximum concentration [occurring at 174 ft (53 m)] estimated by EPA – Screen 3 Model (v. 96043). Maximum concentration location is expected to be "on-site."
[c] Annual concentrations reflect 33% estimated (conservative) annual usage factor.
[d] Estimated concentration in this table includes all NO_x compounds and not only NO_2 for NAAQS.

patterns would be re-established in short duration.

Five 200-kW diesel backup generators would be tested for short durations several times a year. Periodic discharges from these generator testings would not affect overall air quality, and effects on air quality from the construction or operation of the proposed SNS would be negligible.

5.3.5 ECOLOGICAL RESOURCES

This section describes the potential effects that the proposed SNS would have on ecological resources at LANL.

5.3.5.1 Terrestrial Resources

Construction of the proposed SNS in TA-70 would result in the clearing of vegetation from 110 acres (45 ha) of land dominated by piñon-juniper woodlands and scattered juniper savannas. This clearing represents approximately 10 percent of the land area within TA-70. Implementation of erosion control measures and revegetation of disturbed areas would minimize soil erosion during construction.

Rocky Mountain elk use piñon-juniper woodlands for wintering habitat, and some year-round use of these areas by elk has been documented. However, because 90 percent of the land in TA-70 would remain undeveloped after construction of the proposed SNS, minimal impacts on the movements of elk or other wildlife across this area would be expected from implementation of the proposed action. Losing 10 percent of the piñon-juniper habitat in TA-70 would not be expected to affect bird populations that use the area for roosting, feeding, and reproduction.

Clearing operations for construction of the SNS may cause the direct loss of small animals. Also, wildlife would be displaced from cleared areas and the surrounding habitat. Large mammals would be mostly excluded from controlled areas by access control fences.

Construction and operation activities and the associated noise and human presence would disturb wildlife occupying areas adjacent to the proposed site. This could result in emigration of some sensitive species from the surrounding area, although many of the species would adjust to the disturbance. To help minimize disturbance to wildlife, construction machinery would be kept in proper operating condition and workers would be prevented from entering undisturbed areas delineated before construction.

The proposed SNS would operate on land where natural features will have been largely removed or altered by construction activities. Consequently, the proposed SNS operations would have a minimal effect on terrestrial resources at this location and in immediately adjacent areas.

5.3.5.2 Wetlands

Construction and operation of the proposed SNS would not be expected to affect wetlands since these resources are not located on or near the proposed site. Cooling tower blowdown released to an arid land drainage feature would not reach the intermittent riverine wetlands associated with the arroyos in Ancho Canyon or the unnamed canyon to the northeast, except possibly in the case of a heavy rain event.

Overland runoff would be mitigated by the approximately 2-acre (0.81-ha) SNS retention basin. Consequently, the proposed action would have a minimal effect on wetland areas.

5.3.5.3 Aquatic Resources

Construction and operation of the proposed SNS would not be expected to affect aquatic resources since these resources are not located on or near the proposed site. All aqueous discharges from the proposed SNS would be directed to the retention basin. A water outflow from the basin of up to 350 gpm (1,325 lpm) would empty into dryland drainage. This discharge would not be expected to reach the Rio Grande River.

5.3.5.4 Threatened and Endangered Species

Construction of the proposed SNS would reduce the foraging habitat for the American peregrine falcon and the foraging and roosting habitat for the bald eagle in TA-70 by approximately 10 percent. The nearest identified peregrine falcon nesting habitat is in White Rock Canyon, approximately 1.2 miles (1.9 km) from the proposed SNS site. The area surrounding the site would not be extensively used by peregrine falcons (Johnson 1985). The bald eagle uses White Rock Canyon and connecting canyons for foraging and roosting. Also, this species may use White Rock Canyon as a migration route.

These small reductions in nonnesting habitat would result in permanent, but minimal effects on the peregrine falcon and bald eagle.

A systematic survey of the potential habitat areas for protected species would be conducted prior to the start of land clearing and construction on the proposed SNS site. Because definitive identification of many protected plants can only be made when the plant is flowering, this survey would extend over the spring, summer, and fall seasons to maximize the probability of finding them. If found, appropriate mitigation measures would be taken to protect these species during construction and operation of the proposed SNS. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4).

5.3.6 SOCIOECONOMIC AND DEMOGRAPHIC ENVIRONMENT

The socioeconomic impact section identifies whether construction and operation of the proposed project (and associated worker in-migration from outside the ROI) may adversely affect regional services and infrastructure. It also presents an estimate of the financial effects (employment, income, taxes, and economic output) that would be generated locally in the form of worker salaries, indirect effects, and induced effects. Unless otherwise noted, economic effects are described in escalated-year dollars.

The ROI associated with the LANL site includes Los Alamos, Rio Arriba, and Santa Fe Counties in New Mexico. This 7,800-mi^2 (20,202-km^2) region was selected because it forms the area within which at least 90 percent of Los Alamos workers currently reside. It is, therefore, the region within which the majority of socioeconomic impacts are expected to occur. Socioeconomic effects beyond the ROI are generally expected to be minor.

The total local construction cost is estimated to be approximately $332 million (escalated dollars), and the peak construction year would be 2002, when 578 workers would be on-site (Brown 1998a). Of this total, about three-fourths (433 individuals) would likely be hired from the local area, and 144 would come from outside the ROI. An approximate average of 300 workers per year would be on-site, including all construction, management, and engineering design personnel and other technical and commissioning staff. Construction of the 1-MW SNS is the bounding case for analysis of construction effects. If the SNS is upgraded to 4 MW, additional construction would occur, but this would be much less than the effects associated with the initial construction of the 1-MW SNS.

Operations of the proposed SNS at 1 MW would begin in the year 2006 with a staff of 250 persons. Later, if the proposed SNS is upgraded to 4 MW, 375 persons would be employed. The 4-MW case is used for this analysis as the bounding case, and the effects of the proposed 1-MW SNS on the ROI would be similar but slightly less than the 4-MW case.

5.3.6.1 Demographic Characteristics

It is assumed that approximately 75 percent of all construction workers would come from the local area (Brown 1998a). Most of the construction workers would be general craft laborers, and the specialized technical components would be contracted out and fabricated in places not yet known. All locally hired construction workers would commute to the job site from existing residences and would not relocate closer to the site. The experience with other past major construction projects is that most in-migrating workers would temporarily move to the project area but would usually commute home on weekends or periodically. These individuals would generally not bring families to the local area for the construction period. However, even if all of the in-migrating workers brought families into the area, the total (temporary) population increase would be less than 500 persons in the peak year, including spouses and children. This would be a temporary increase in population of about 0.02 percent and is, therefore, negligible.

People with the technical expertise needed to operate the proposed SNS currently reside in the ROI. However, it is also expected that some plant operators would come from outside the local region. It is assumed that about half of the 375-person operating (for the bounding 4-MW case) workforce would come from outside the area. It is further assumed that these households would be the same size as the national average because it is not known from where they would in-migrate. It is conservatively estimated that in 2006 the total population increase associated with operations would be about 600 individuals, including spouses and children. The facility operators would be “permanent” residents of the ROI, and little additional in-migration would occur in subsequent years. The population increase associated with construction and operations would represent about 0.03 percent of the local population and is, therefore, negligible.

5.3.6.2 Housing

With about 6,900 vacant “dwelling units” (refer to Section 4.2.6.2) in the three-county ROI, workers should easily be able to find apartments to rent or houses to purchase. Some new houses would probably be constructed. However, existing vacancies and historic construction rates indicate that housing would be available to accommodate this small in-migration.

5.3.6.3 Infrastructure

Potential impacts on infrastructure are closely tied to population growth. Because the expected permanent in-migration is only 600 individuals, effects upon infrastructure would be relatively minor.

Nearly 29,000 students reside in the area. The addition of less than 300 children to the ROI would, therefore, be minor. Even if all 300 children attended schools in Los Alamos County, the current teacher-student ratio of 1:15 would be unchanged. Effects would also be minor for police and fire protection, health care, and other services.

5.3.6.4 Local Economy

Design of the proposed SNS would begin in 1999, and the first construction managers and workers would begin work in FY 2000. The majority of the construction would occur from FY 2001 through FY 2004, with the peak construction employment occurring in FY 2002. Testing of the proposed SNS would be from FY 2003 through FY 2005. Operations are planned to begin by the end of FY 2005; FY 2006 would be the first full year of operations (see Figure 3.2.2-1).

Table 5.3.6.4-1 presents the results of the IMPLAN modeling for the period 1999 through 2006. Economic benefits in the form of jobs, wages, business taxes, and income would begin to accrue during the first year of the project in FY 1999. These economic benefits in the ROI would increase as construction and other associated project activities increase. Design and construction employment would be highest in FY 2002, and there would be an estimated 1,447 total (direct, indirect, and induced) new jobs created at LANL. This trend would begin to diminish in FY 2003 as design and construction employment decreased and would continue to decrease until construction is completed in FY 2004. Facility operations would begin in FY 2005. Operations would reflect substantial regional spending for operator salaries, supplies, utilities, and administrative costs.

The proposed SNS is planned to operate for 40 years. If the level of operation is the same as the 4-MW case measured in the first full year (FY 2006), it is estimated that facility operation would continue to support 1,486 jobs for each of the following years of operation. Other annual operations effects would include \$66.8 million in local wages, \$7.6 million in business taxes, \$71.4 million in personal income, and \$171.6 million in total output.

Construction of the facility would create new jobs and may potentially result in the region’s unemployment rate dropping from 6.6 percent to 5.8 percent. During operations, the unemployment rate may decrease further, depending on whether construction workers and engineers (unemployed following project completion) stay in the ROI. The effects of operating the proposed 1-MW SNS would be similar but slightly lower.

5.3.6.5 Environmental Justice

As identified in Figures 4.2.6.5-1 and 4.2.6.5-2, minority populations and low-income populations reside within 50 miles (80 km) of the proposed SNS site. The minority populations living around the proposed site are mostly Native American and Hispanic. For environmental justice impacts to occur, there must be high and adverse human health or environmental impacts that disproportionately affect minority populations or low-income populations.

Table 5.3.6.4-1. LANL IMPLAN modeling results—construction and operations impacts.

	1999	2000	2001	2002	2003	2004	2005	2006
Employment								
Direct	92	195	448	531	369	245	34	640
Indirect	82	147	353	441	317	217	30	288
Induced	87	161	384	476	340	232	32	558
Total	261	503	1,185	1,447	1,026	694	95	1,486
Wages								
Direct	$6,610,816	$12,470,472	$30,283,823	$38,259,362	$27,888,348	$19,401,919	$2,716,178	$44,814,575
Indirect	$2,035,776	$3,730,568	$9,121,179	$11,624,370	$8,516,543	$5,954,408	$833,978	$8,781,731
Induced	$1,826,780	$3,430,981	$8,318,759	$10,493,959	$7,636,286	$5,303,408	$741,161	$13,209,288
Total	$10,473,371	$19,632,020	$47,723,761	$60,377,691	$44,041,177	$30,659,735	$4,291,317	$66,805,595
Business Tax								
Direct	$178,758	$425,227	$973,483	$1,139,218	$790,864	$524,064	$73,037	$3,282,725
Indirect	$341,175	$629,504	$1,532,020	$1,941,854	$1,416,708	$986,383	$137,798	$1,302,234
Induced	$416,484	$781,464	$1,892,840	$2,385,320	$1,733,919	$1,202,897	$167,919	$2,989,309
Total	$936,417	$1,836,194	$4,398,343	$5,466,393	$3,941,491	$2,713,345	$378,754	$7,574,269
Income								
Direct	$7,189,941	$13,608,341	$33,015,093	$41,663,724	$30,349,857	$21,101,180	$2,953,885	$45,883,971
Indirect	$2,291,450	$4,210,366	$10,294,973	$13,119,963	$9,614,889	$6,724,403	$942,463	$10,341,188
Induced	$2,094,716	$3,935,365	$9,544,454	$12,043,588	$8,766,393	$6,089,960	$851,317	$15,176,644
Total	$11,576,106	$21,754,073	$52,854,520	$66,827,274	$48,731,139	$33,915,543	$4,747,665	$71,401,805
Output								
Direct	$23,287,632	$44,348,648	$107,410,220	$135,264,146	$98,411,126	$68,341,639	$9,565,690	$101,858,828
Indirect	$5,662,857	$10,547,981	$25,664,403	$32,527,007	$23,755,543	$16,561,696	$2,319,388	$27,128,753
Induced	$5,849,635	$10,998,301	$26,695,085	$33,711,512	$24,557,695	$17,073,685	$2,388,646	$42,617,261
Total	$34,800,123	$65,894,930	$159,769,708	$201,502,664	$146,724,363	$101,977,020	$14,273,724	$171,604,842

Source: IMPLAN Pro.

The human health and safety analyses show that hazardous chemical and radiological releases from normal operations of the proposed SNS at 1-MW and 4-MW power levels would be within regulatory limits. Annual radiological doses are given in Section 5.3.9, and the data show that normal air emissions of the proposed 1-MW SNS would be negligible and would not result in adverse human health or environmental impacts to the public off-site. Therefore, operation of the proposed SNS would not have disproportionately high and adverse impacts on minority or low-income populations.

Radiation doses to the public from both normal operations and accident conditions would not create high and adverse impacts. Less than one (0.1) LCF is calculated at the 4-MW power level over a 40-year operations period. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the calculated number of LCFs would be reduced (refer to Section 5.2.9.2.1). Twenty-five accident scenarios at the SNS would result in airborne releases. The consequences of most of these accidents would be negligible at power levels of both 1 MW and 4 MW. Only one accident is calculated to induce LCFs in the off-site population. An LCF is a cumulative measure from the entire population (within 50 miles or 80 km radius) of approximately 250,000 people used for comparing alternatives and does not necessarily indicate that a fatality would occur (see Section 5.2.9.2.1). If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the calculated number of LCFs would be reduced (see Section 5.2.9.2.1). Winds over the plateau show considerable spatial structure and temporal variability, but a southerly flow usually prevails during the day. The prevailing nighttime flow over the western portion of the site is west-southwesterly to northwesterly (Figures 4.2.3.2-1 and 4.2.3.2-2). Figures 4.2.6.5-1 and 4.2.6.5-2 show that the proposed SNS site is completely surrounded by minority and low-income populations greater than the national average. The highest concentrations of these communities are located to the north of the site, and the highest concentration of non-minority and higher income populations are located closest to the site on the north, south, and western borders (DOE-AL 1995b, Figures 4-22 and 4-24). The public, including minority and low-income persons, could be in the path of an off-site airborne release. However, the analysis has shown that there would not be high and/or adverse impacts to any of the population; therefore, there would be no disproportionate risk of significantly high and adverse impacts to minority and low-income populations.

A number of uncertainties are associated with the evaluation of potential impacts due to subsistence consumption. ANL developed an article reviewing the literature on subsistence consumption (Elliot 1994) and found that (1) ”the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns. . . At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level;” (2) “a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations;” (3) “the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases the studies were not motivated by minority exposure concerns;” and (4) “the majority populations were not significantly higher than for the population as a whole." Specific data on subsistence populations are not available for the LANL region. However, DOE is unaware of any subsistence populations residing in the vicinity of the proposed SNS site. Therefore, no adverse impacts on such populations are expected.

To assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the spring of 1996. The newsletter is available in the public reading rooms. Three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation;" (2) "to provide information about projects and programs at DOE and other federal and state agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation;" and (3) "to receive relevant information from readers." In addition to the newsletter, DOE has a new project under way to identify information being collected on subsistence consumption by other federal agencies and to serve as a clearinghouse for such information (DOE 1996e).

All of the wastes generated during construction and operations would be transferred to LANL waste operations for processing. The waste management facilities and the disposal processes for these wastes are described in Section 5.3.11. However, the LANL treatment facility cannot accommodate wastes from tritium, and an alternative disposal method would be necessary for these wastes from the SNS. All chemical releases would be regulated by NPDES permits and would be in compliance with federal and state regulations. As such, there would be no incremental effects on fish or other edible aquatic life in areas surrounding the proposed SNS site.

The analyses indicate that socioeconomic changes resulting from implementing the proposed SNS would not lead to environmental justice impacts. The proposed SNS project would provide economic benefits through generating additional employment and income in the affected region (refer to Table 5.3.6.4-1). Traffic congestion would increase; however, this impact would not disproportionately affect minority or low-income communities because traffic patterns would not be different between low-income and minority populations and the rest of the surrounding population (refer to Section 5.3.10.1). Overall, nothing associated with construction or operation of the proposed SNS would pose high and adverse human health or environmental effects that disproportionately affect minority and low-income populations.

5.3.7 CULTURAL RESOURCES

The potential effects of the proposed action on cultural resources in the vicinity of the proposed SNS site at LANL are assessed in this section. These assessments involve prehistoric archaeological sites; structures, features, and archaeological sites dating to the Historic Period; and TCPs.

The SNS design team has not established the areas where construction or improvement of utility corridors and roads would be necessary to support the proposed SNS at LANL. In addition, the locations of ancillary structures such as a retention basin, switchyard, and waste treatment system have not been determined. As a result, the effects of the proposed action on any cultural resources that may occur in these areas cannot be assessed at this time. If the proposed SNS site at LANL were chosen for construction, a cultural resources survey and an assessment of potential effects would be conducted prior to the initiation of construction-related activities in these areas. Appropriate measures would be implemented to mitigate any identified effects on cultural resources. These measures would include avoidance, where possible, or data recovery operations, including detailed recording of surface features and/or archaeological excavation.

Approximately 35 percent of the proposed SNS site and an associated buffer zone have not been surveyed for cultural resources. If the proposed site at LANL were chosen for construction of the SNS, a survey of this area and an assessment of specific effects on cultural resources would be conducted prior to the initiation of construction-related activities in these areas. These effects would be mitigated through data recovery operations, including detailed recording of surface features and/or archaeological excavation.

5.3.7.1 Prehistoric Resources

Five prehistoric archaeological sites have been identified on and adjacent to the proposed SNS site at LANL. These sites are pueblos with 2 to 10 rooms and field houses with 1 to 2 rooms. Three of the sites date to the Coalition Period (A.D. 1100-1325), and two sites date to the Classic Period (A.D. 1325-1600).

All of these sites are significant cultural resources, and they are eligible for listing on the NRHP under Criterion D. Construction on the proposed SNS site would affect these cultural resources. They would be destroyed by site preparation activities. In the unsurveyed area of the proposed SNS site, any prehistoric sites listed on or eligible for listing on the NRHP would also be destroyed during site preparation. These effects would be mitigated through archaeological data recovery.

5.3.7.2 Historic Resources

No archaeological sites, structures, or features dating to the Historic Period have been identified on the surveyed portion (65 percent) of the proposed SNS site or in its vicinity. Consequently, in these areas, no Historic Period cultural resources listed on or eligible for listing on the NRHP would be affected by implementation of the proposed action. Site preparation activities in the unsurveyed portion (35 percent) of the proposed SNS site would destroy any historic sites, structures, or features listed on or eligible for listing on the NRHP. These effects would be mitigated through data recovery.

5.3.7.3 Traditional Cultural Properties

Five prehistoric archaeological sites have been identified on and adjacent to the SNS site at LANL. All are located within the 65 percent area that has been surveyed for cultural resources. These sites would be considered TCPs by American Indian groups in the area. They would be destroyed by site preparation activities associated with construction of the proposed SNS. If any prehistoric archaeological sites are located within the unsurveyed 35 percent of the proposed SNS site, these TCPs would also be destroyed by site preparation.

Some tribal groups have identified water resources (surface water and groundwater) as TCPs (DOE-AL 1998: 5-120). As discussed in Sections 5.2.2.3 and 5.2.10.2.3, the high water demand of the SNS during operations could adversely affect local groundwater supplies.

The specific identities and locations of other TCPs on and adjacent to the SNS site are not known and cannot be reasonably estimated (see Section 4.2.7.3). As a result, the specific effects of the proposed action on such TCPs would be uncertain.

DOE and the LANL Cultural Resource Management Team have implemented a program to manage the laboratory's cultural resources for compliance with the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act. When an action is proposed, DOE and LANL arrange for site visits by tribal representatives, particularly representatives of the San Ildefonso, Santa Clara, Jemez, and Cochiti pueblos. These consultations are used to solicit concerns and comply with applicable requirements and agreements. If the SNS site at LANL were selected for construction, representatives of tribal groups and the Hispanic community would be further consulted about the occurrence of specific TCPs on and adjacent to the SNS site. If any are identified, potential effects of the proposed action on these resources would be assessed. If effects would occur, appropriate and feasible mitigation measures would be designed and implemented in consultation with the affected groups and communities. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4).

5.3.8 LAND USE

The potential effects of the proposed action on land use in the vicinity of LANL, within the boundaries of LANL, and on the SNS site are assessed in this section. The assessments cover potential effects on current land use and zoning for future land use. Furthermore, the potential effects of the proposed action on parklands, nature preserves, major recreational resources, and visual resources are assessed.

5.3.8.1 Current Land Use

Current land use in the urban areas and tribal lands surrounding LANL is driven by the relationship between existing land characteristics and socioeconomic forces acting at the local and regional levels. Similarly, current land use in Santa Fe National Forest, Bandelier National Monument, and LANL result from the selective use of existing land characteristics to meet federal mission requirements. The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic land characteristics and other forces that influence land use in these areas. Therefore, implementation of the proposed action on the SNS site at LANL would have no reasonably discernible effects on current land use in the vicinity of the laboratory and across the laboratory as a whole. However, uses of the land within and near the proposed SNS site would be more subject to effects.

The current use of land on and adjacent to the proposed SNS site in TA-70 is categorized as Environmental Research/Buffer. This classification indicates that the land is largely undeveloped open space suitable for use in NERP environmental research and as a buffer zone between activity areas at the laboratory. The proposed action would introduce large-scale development to the proposed SNS site, utility corridors, and rights-of-way. Current land use on the site would change from Environmental Research/Buffer to Experimental Science.

The 110-acre section (45 ha) of undeveloped land on the proposed SNS site is only about 3 percent of the total undeveloped land in TA-6, 69, 70, and 71 and only about 0.6 percent of the 16,000 acres (6,478 ha) of LANL land that has never been developed. In addition, the piñon-juniper woodlands that cover the proposed SNS site constitute less than 1 percent of the 12,770 acres (5,108 ha) of piñon-juniper woodlands at LANL. Consequently, the loss of 110 acres (45 ha) of undeveloped piñon-juniper woodlands would represent a minimal effect on undeveloped lands as a whole at LANL.

DOE has a federally mandated role as trustee of the natural and cultural resources on its lands. The use of undeveloped trusteeship land for the SNS is proposed only because no previously developed LANL lands that meet project requirements are available.

The land on and in the vicinity of the proposed SNS site is not being used for environmental research projects. As a result, the proposed action would have no effects on the use of land by such projects.

5.3.8.2 Future Land Use

The land on the proposed SNS site is zoned for future use in Experimental Science. This zoning category applies to land reserved for the construction and operation of future research facilities. The proposed SNS would be a new research facility. Consequently, implementation of the proposed action would have no potential effects relevant to current DOE zoning of the proposed SNS site.

Portions of the proposed SNS site would become contaminated with pollutants from operations. Current plans call for in-situ decommissioning of the SNS when its operational life cycle is completed. As a result of in-situ decommissioning, some contaminated components would remain in place on the SNS site. This could limit the future use of land on the site for other purposes. Construction and operation of the SNS could also limit the future use of land areas adjacent to the SNS site.

No future uses of proposed SNS site and vicinity land for environmental research are planned. As a result, effects of the proposed action on specific future research projects cannot be assessed.

5.3.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics and other factors that support park, nature preserve, and recreational land uses outside the LANL boundaries. Consequently, implementation of the proposed action on the SNS site at the laboratory would have minimal effects on the use of nearby land for Santa Fe National Forest or Bandelier National Monument.

The proposed action would have no reasonably discernible effects on most recreational uses of LANL land, and it would have no effect on environmental research activities within the NERP. However, public use of the hiking trails located near the proposed SNS site could potentially be restricted or eliminated.

5.3.8.4 Visual Resources

The proposed SNS facilities would be located in a remote woodland area. Their presence would change the viewscape of the area from that of undeveloped pinion-juniper woodlands to industrial development. During construction and operations, they would be visible to travelers along State Route 4 and the access road leading to the facilities. The SNS facilities would also be visible from points on the proposed SNS site and various points within TA-70. This would include locations on the recreational hiking trails used by the public in TA-70. During the night hours, facility lighting would be highly noticeable to viewers because no other large, lighted facilities are present in this remote area.

These facilities would not be visible from the nearby community of White Rock or popular public use areas in Bandelier National Monument.

5.3.9 HUMAN HEALTH

Construction and operation of the proposed SNS at LANL could pose a potential risk of adverse effects on the health of workers and of the public living in the vicinity of the facility. Potential adverse effects include:

- Traffic-related fatalities and injuries to workers and the public.
- Occupational fatalities and injuries to workers.
- Exposure of workers and the public to radiation or radioactive materials.
- Exposure of workers and the public to toxic or hazardous materials.

This section evaluates the potential magnitude of these effects and the likelihood that they would occur during three phases or conditions:

- construction,
- normal operations, and
- accident conditions.

5.3.9.1 Construction

The potential effects on the health of construction workers, other LANL workers, and members of the public would be essentially the same as those for any of the proposed locations because the size of the construction work force would be the same. Potential effects of construction of the SNS include construction accidents and traffic accidents.

On the basis of national traffic accident rates (1.74×10^{-8} fatalities per vehicle mile and 1.05×10^{-6} disabling injuries per vehicle mile) and the anticipated total mileage of commuting construction workers (2,074 person-years × 250 work days/person-year × 0.806 daily round-trips/worker × 20 miles/round trip), less than one additional fatality and nine additional disabling injuries could occur as the result of increased commuter traffic during the seven-year construction period of the proposed SNS.

On the basis of national construction accident rates, 0.31 fatality (0.00015 fatalities/worker-year × 2,074 worker-years) and 110 disabling injuries (0.053 disabling injuries/ worker-year × 2,074 worker-years) could occur as the result of occupational accidents during construction of the proposed SNS. The existing LANL workforce of 8,655 is smaller than that of ORNL and larger than BNL and ANL, so that the relative increase in traffic-related injuries and fatalities would be slightly greater during construction of the proposed SNS facility at LANL. Based on traffic data shown in Section

5.3.10.1 and the approach described in Section 5.2.9.1, traffic-related disabling injuries and fatalities would be expected to increase by approximately 6.7 percent during the peak year of construction relative to existing injury and fatality rates at LANL.

No known construction activities or requirements would place construction workers at the proposed SNS facility and the public at LANL at a different risk of occupational injury or fatalities than the risk posed to these same groups by construction at any of the proposed locations.

The previous discussion is based on construction of the 1-MW proposed SNS facility. At this stage of design, estimates of the number of workers that would be required to upgrade the facility for 4-MW operation are not available. Because the amount of construction required for upgrade to 4-MW would be less than that required for construction of the original facility, injuries and fatalities for traffic-related and construction accidents for the 4-MW facility would be less than those for construction of the original facility regardless of where the SNS is located.

5.3.9.2 Normal Operations

The number of SNS workers is independent of the location of the facility. The absolute number of industrial accidents and traffic-related injuries and fatalities would be expected to be essentially the same as at the other proposed locations.

On the basis of national traffic accident rates (0.0174 fatalities per million vehicle-mile and 1.05 disabling injuries per million vehicle-mile) and the anticipated total mileage of 60 million miles (375 commuting workers × 20 miles/trip × 0.806 trips/day × 250 days/year × 40 years), one additional fatality and 63 additional disabling injuries could occur as the result of increased commuter traffic during the 40-year operational life of the proposed SNS.

National industrial workplace accident rate data applied to the work force for the proposed SNS would yield less than one fatality (3.4 deaths annually/100,000 workers × 375 workers × 40 years) and 500 disabling injuries (3,400 disabling injuries annually/100,000 workers × 375 workers × 40 years) occurring over the 40-year operational life of the proposed SNS.

The relative increase of disabling injuries and fatalities would be less than the other proposed locations at LANL because of the larger existing work force. Based on data shown in Section 5.3.10.1, the addition of the maximum of 375 SNS workers to the daily LANL traffic flow could increase the number of disabling injuries and fatalities by approximately 4.3 percent relative to existing rates at LANL.

The proposed SNS facility would generate and release direct radiation, radioactive materials, and toxic materials. Members of the public and workers at the proposed SNS facility and other adjacent facilities would be exposed to these radiations and emissions. The quantities and release rates of these materials would be the same for any of the proposed locations. The impact of the LANL site-specific meteorology, distances to site boundaries, and population density and distribution are discussed in the following sections.

5.3.9.2.1 Radiation and Radioactive Emissions

This section assesses the effects of direct radiation and airborne emissions of radioactive materials from the proposed SNS based on the methods and dose-to-risk conversion factors discussed in Section 5.1.9.

Direct Radiation

Exposure of SNS workers to direct radiation at LANL is expected to be the same as at other proposed locations because the SNS Shielding Design Policy is applicable regardless of location (e.g., ORNL, LANL, ANL, or BNL).

Because the preferred location of the proposed SNS facility at LANL is remote from other facilities and at generally greater distances from areas where members of the public could reside, direct radiation exposures to the public may be somewhat less than for other proposed locations. This difference, if real, would be small and cannot be quantified based on information currently available.

Radioactive Emissions

Radioactive emissions during normal operations of the proposed SNS at LANL would include airborne releases from the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack. These emissions are the same regardless of facility location and are listed in Table G-1 of Appendix G. As discussed in Section 5.3.11, the LLLW and process waste generated by the proposed SNS facility at LANL would be handled by the TA-53 radioactive liquid waste (RLW), which is currently under construction.

The estimated annual doses to workers and the public for normal airborne emissions from the proposed SNS facility are shown in Table 5.3.9.2.1-1. The methods and assumptions used in the calculation of doses is discussed in Section 5.1.9 and in greater detail in Appendix G.

Even under the conservative assumptions made in this assessment regarding exposure pathways, doses shown in Table 5.3.9.2.1-1 for the maximally exposed individuals are comparable to those for the maximally exposed individuals for existing LANL operations, but SNS population doses are higher. Calculations reported by LANL for National Emissions Standards for Hazardous Air Pollutants (NESHAP) compliance estimated a dose of 1.93 mrem/yr to the maximally exposed individual in 1996 (LANL 1997d). More realistic calculations, based on a combination of environmental measurements and transport modeling, estimated a median dose of 1.4 mrem/yr to the maximally exposed individual and a dose of 1.2 person-rem to the off-site population (LANL 1997d). LANL estimates that 99 percent of these doses are the result of airborne releases.

Annual doses to the maximally exposed individual for proposed SNS operations at LANL would be 0.47 mrem at 1 MW and 1.8 mrem at 4 MW. Population doses from the proposed SNS facility would be 2.0 person-rem at 1 MW and 5.3 person-rem at 4 MW. Using the information from the LANL environmental report (LANL 1997d), this would increase the estimated dose to the maximally exposed individual to 2.4 mrem, which is 24 percent of the 10-mrem limit (40 CFR Part 61) that DOE expects the facility to meet.

Table 5.3.9.2.1-1. Estimated annual radiological dose from proposed SNS normal emissions at LANL.[a]

Receptor	1-MW Power Level: Target Building[b]	1-MW Power Level: Tunnel Confinement[c]	4-MW Power Level: Target Building[b]	4-MW Power Level: Tunnel Confinement[c]
Maximum Individuals (mrem)				
Off-site Public[d]	0.46	0.008	1.8	0.009
Uninvolved Workers[d]	0.098	0.12	0.39	0.19
Populations (person-rem)				
Off-site Public[e] (246,294 persons)	2.0	0.036	5.2	0.032
Uninvolved Workers[e] [None within 1.2 miles (2 km)]	NA	NA	NA	NA

[a] Doses shown include the contributions from inhalation, immersion, and "ground shine" for workers and the off-site public and ingestion for the off-site public.
[b] Target Building emissions include hot off-gas exhaust, primary confinement exhaust, secondary confinement exhaust from the target building, and activated air from the beam dump buildings.
[c] Tunnel confinement emissions include activated air and concrete dust from the linac tunnel, HEBT tunnel(s), ring tunnel(s), and ring-to-target beam transport tunnel(s).
[d] The maximally exposed individuals are hypothetical receptors. The member of the public is assumed to occupy a position at the LANL site boundary for 8,760 hr/yr and to produce the entire food supply at this location. The maximally exposed uninvolved worker is assumed to occupy a position within 1.2 miles (2 km) of the stack for 2,000 hr/yr.
[e] The off-site population consists of all individuals residing outside the LANL site boundary within 50 miles (80 km) of the site and is assumed to be present for 8,760 hr/yr. The involved/uninvolved worker population consists of all workers normally within 1.2 miles (2 km) of the facility. There are no workers within 1.2 miles (2 km) of the preferred SNS location at LANL.
NA - Not applicable. No workers within 2 km.

Dose at the LANL boundary due to emissions from Tunnel Confinement Exhaust is 0.008 mrem and is dominated by radionuclides in activated concrete dust. Dose at the LANL boundary due to emissions from Target Building Exhaust would be dominated by ^{3}H (58 percent), with smaller contributions from ^{14}C, ^{203}Hg, ^{125}I, and ^{121}Te. These radionuclides are listed in order of decreasing dose and account for 99 percent of the dose of this component of the total air pathway dose.

To estimate the total risk to members of the public from the proposed SNS facility emissions of radioactive materials over the entire life of the facility, annual population dose is multiplied by operating life of the facility and by the dose-to-risk conversion factor of 0.0005 LCF per person-rem. For 40 years of operation at 1 MW, 0.04 excess LCF would be projected. For 40 years at 4 MW, 0.1 excess LCF would be projected. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, 0.09 excess LCF would be projected. These projected excess LCFs do not mean that any actual fatalities would occur as the result of the proposed SNS operations, but provide a quantified magnitude for comparison to excess LCFs estimated for the other alternatives.

5.3.9.2.2. Toxic Material Emissions

As discussed in Section 5.2.9.2.2, elemental mercury vapor is the only toxic material expected to be released from the proposed SNS facility under normal conditions. The mercury would be released from the Target Building Exhaust Stack at an annualized rate of 0.0171 mg/s. Based on atmospheric dispersion factors specific to LANL, the maximum mercury concentration in areas that could be occupied by uninvolved workers is 2.35×10^{-6} mg/m^3 in any 2-hr period and 3.41×10^{-7} mg/m^3 in any 8-hr period. These concentrations are at least 1/100,000th of the OSHA ceiling limit (0.1 mg/m^3) and the ACGIH-recommended threshold limit value-time weighted average (TLV-TWA) (0.05 mg/m^3) for workers. The average annual airborne mercury concentration at the site boundary would be 8.77×10^{-9} mg/m^3, 1/35,000th of the EPA Reference concentration for members of the public (0.0003 mg/m^3).

5.3.9.3 Accident Conditions

This section discusses the impacts on human health of accidents that could potentially occur during operation of the proposed SNS at LANL.

5.3.9.3.1 Accident Scenarios

The accident scenarios and source terms for accidents that could potentially occur at the proposed SNS facility are the same for all proposed sites and are summarized in Table G-2 (refer to Appendix G). The details of these scenarios and source terms is provided in Appendix C. Table 3.2 defines the terminology used to describe the likelihood that a given accident could occur.

5.3.9.3.2 Direct Radiation

The frequencies of occurrence and consequences of accidents involving exposure to direct radiation have not been specifically analyzed. DOE’s Shielding Design Policy for the proposed SNS is such that for the worst-case design-basis accident, the dose to the maximum exposed individual in an uncontrolled area would be limited to 1 rem, and a worker in a controlled area would be limited to 25 rem. The risks of this category of accidents would be the same for all proposed sites.

5.3.9.3.3 Radioactive Materials Accidents

DOE has performed a hazard analysis of potential accidents at the proposed SNS facility, and for those that could result in a release of radioactive material, it has estimated source terms. The DOE analysis is included as Appendix C. Accident scenarios, estimated frequencies of occurrence, and source terms are summarized in Table G-2 and are the same for all proposed SNS sites. The methods used to evaluate the consequences of these accidents are discussed in Section 5.1.9 and in more detail in Appendix G.

Doses for these accidents, should they occur at the proposed SNS facility at LANL, are listed in Table 5.3.9.3.3-1. With the exception of accident ID 16, all doses for accidents at a 4-MW facility would be four times higher than at a 1-MW facility. This is not the case for ID 16, the beyond-design-basis mercury spill, due to differences in the source term model (refer to Exhibit F of Appendix C). At 4 MW (ID 16b) some boiling of mercury is assumed, releasing a larger quantity of mercury than at 1 MW (16a) where only evaporation is assumed.

Table 5.3.9.3.3-1. Radiological dose for SNS accident scenarios at LANL.

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
A. Accidents Involving Proposed SNS Target or Target Components											
2	Major Loss Of Integrity of Hg Target Vessel or Piping (Appendix C, Section 3.3)	a) Unlikely	Percent Inventory Mercury Iodine 0.142 0.142	1.2	4.8	4.9	19.6	12.0	48.0	NA	NA
		b) Extremely Unlikely	Percent Inventory Mercury Iodine 0.243 100	4.0	16.0	11	44	49	196	NA	NA
8	Loss of Integrity in Target Component Cooling Loop (Appendix C, Section 3.9)	a) Anticipated	Bounded by Annual Release Limits[d]	<10	<10	NA	NA	NA	NA	NA	NA
		b) Anticipated	Gases + Mist + 150 L of D_2O	0.33	1.32	0.41	0.84	1.7	6.8	NA	NA
		c) Anticipated	18 L of D_2O	<0.001	<0.001	0.002	0.008	0.003	0.012	NA	NA
		d) Anticipated	Gases + Mist + 150 L of H_2O	0.29	1.16	0.36	1.44	1.1	4.4	NA	NA
16	Beyond-Design-Basis Hg Spill (Appendix C, Section 3.17)	a) Beyond Extremely Unlikely	1 MW Percent Inventory Mercury Iodine 1.11 100	9.0		35		88		NA	
		b) Beyond Extremely Unlikely	4 MW Percent Inventory Mercury Iodine 1.28 100		590		1,100		8,000		NA

Table 5.3.9.3.3-1. Radiological dose for SNS accident scenarios at LANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
B. Accidents Involving Proposed SNS Waste Systems											
17	Hg Condenser Failure (Appendix C, Section 4.1.1)	Anticipated	13.7 g mercury	0.002	0.008	0.006	0.024	0.025	0.10	NA	NA
18	Hg Charcoal Absorber Failure[e] (Appendix C, Section 4.1.2)	Unlikely	14.8 g mercury	<0.001	<0.001	0.003	0.012	0.006	0.024	NA	NA
19	He Circulator Failure (Appendix C, Section 4.2.1)	Anticipated	1 day of tritium production	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	NA	NA
20	Oxidation of Getter Bed (Appendix C, Section 4.2.2)	Unlikely	1 day of tritium production	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	NA	NA
21	Combustion of Getter Bed (Appendix C, Section 4.3.1)	Extremely Unlikely	1 year of tritium production, 200 g depleted uranium	0.97	3.88	1.2	4.8	14	56	NA	NA
22	Failure of Cryogenic Charcoal Absorber [f] (Appendix C, Section 4.4.1)	Unlikely	1 day of xenon production	0.040	0.16	0.023	0.92	0.45	3.6	NA	NA
23	Valve Sequence Error in Tritium Removal System (Appendix C, Section 4.5.1)	Unlikely	1 year of tritium production	0.93	3.72	1.2	4.8	14	56	NA	NA
24	Valve Sequence Error in Offgas Decay System (Appendix C, Section 4.5.2)	Anticipated	7 days of xenon accumulation (1 decay tank)	2.5	10.0	3.0	12.0	36	144	NA	NA

Table 5.3.9.3.3-1. Radiological dose for SNS accident scenarios at LANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
B. Accidents Involving Proposed SNS Waste Systems (continued)											
25	Spill During Filling of Tanker Truck for LLLW Storage Tanks[g] (Appendix C, Section 4.5.3)	Anticipated	0.00005% of Contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA
26	Spray During Filling of Tanker truck for LLLW[g] (Appendix C, Section 4.5.4)	Anticipated	1.9 ml of LLLW	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA
27	Spill During Filling of Tanker Truck for Process Waste Storage Tanks[g] (Appendix C, Section 4.5.5)	Anticipated	51,100 L Process Waste to Surface Water + 57 L to Atmosphere	See footnote “h”		See footnote “h”		See footnote “h”		NA	NA
28	Spray During Filling of Tanker Truck for Process Waste[g] (Appendix C, Section 4.5.6)	Anticipated	28.4 L of Process Waste	See footnote “h”		See footnote “h”		See footnote “h”		NA	NA
29	Offgas Treatment Pipe Break (Appendix C, Section 4.6.1)	Unlikely	24 hrs of xenon production	0.49	1.96	0.17	0.68	3.9	15.6	NA	NA
30	Offgas Compressor Failure (Appendix C, Section 4.6.2)	Unlikely	1 hr of xenon production	0.056	0.224	0.021	0.084	0.52	2.08	NA	NA
31	Offgas Decay Tank Failure (Appendix C, Section 4.6.3)	Extremely Unlikely	7 days of xenon accumulation	2.5	10.0	3.0	12.0	36	144	NA	NA
32	Offgas Charcoal Filter Failure (Appendix C, Section 4.6.4)	Unlikely	7 days of iodine production	0.040	0.160	0.027	0.108	0.21	0.84	NA	NA

Table 5.3.9.3.3-1. Radiological dose for SNS accident scenarios at LANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam	1-MW Beam	4-MW Beam
				B. Accidents Involving Proposed SNS Waste Systems (continued)							
33	LLLW System Piping Failure (Appendix C, Section 4.6.5)	Unlikely	0.00005% of Contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA
34	LLLW Storage Tank Failure (Appendix C, Section 4.6.6)	Extremely Unlikely	0.00005% of Contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA
37	Process Waste Storage Tank Failure (Appendix C, Section 4.6.9)	Extremely Unlikely	57 L to Atmosphere	See footnote "h"		See footnote "h"		See footnote "h"		NA	NA

[a] Unless otherwise indicated, radiological doses are based on radiological source terms for a 1-MW power level and would be four times greater if the facility is operating at 4 MW. These doses are total EDEs and include dose from inhalation and immersion. "Off-site" means outside the site boundary rather than outside the proposed SNS facility boundary. Individual receptors are hypothetical and do not correspond to any actual person. Population receptors are based on the actual number of people residing outside the site boundary and within 50 miles (80 km) of the facility and on the number of site workers normally within 1.2 miles (2 km) of the facility and not involved in facility operation.

[b] See Table 5.2.9-2 for the numerical ranges associated with accident frequencies categories.

[c] Source terms are expressed in units that are independent of power level. Except for beyond-design-basis accidents (IDs 16a, 16b), the radioactivity released in accidents at 4 MW is four times that released at 1 MW.

[d] 40 CFR 61 limits dose to members of the public from airborne emissions from DOE facilities to 10 mrem/yr.

[e] Installation of sulfur-impregnated charcoal filters is being considered to serve as a "polishing filter" for the mercury condenser (refer to Event 17).

[f] Cryogenic charcoal absorbers are being considered as an alternative to the offgas compressor, decay storage tanks, and ambient temperature charcoal filters (refer to Events 24, 30, 31, and 32).

[g] Accidents involving tanker trucks may not be applicable for the proposed SNS facility at this site. It has not been determined how LLLW and process waste would be treated and disposed.

[h] Process waste accidental airborne releases occur at ground level. Only atmospheric dispersion factors for elevated releases were calculated for this site. Based on the radionuclide contents of LLLW, process waste source terms, and results for ORNL, doses for process waste accidents at this site are anticipated to be approximately 0.001 mrem or less for individuals and to be less than approximately 0.050 person-rem for the off-site population.

NA - Not available.

The pattern of accident doses for the proposed SNS facility at LANL is essentially the same as for the other proposed locations, but the magnitude of the doses is somewhat less. This mainly is due to the remoteness of the proposed SNS site at LANL and the lower population density.

At a power level of 1 MW, the beyond-design-basis mercury spill accident (ID 16a) would be the highest dose of the potential accidents involving the target and target system. Maximum doses to individuals would be 9 mrem for the public and 35 mrem for the uninvolved worker. The dose to the member of the public is about 3 percent of the annual dose from natural background radiation and that to the worker is about 12 percent of the dose from natural background radiation. The off-site population dose of 88 person-rem corresponds to 0.044 excess LCF.

At a power level of 1 MW, accident IDs 24 and 31 involving the offgas decay system have the highest doses of potential accidents involving waste handling systems. In these two accidents, maximum individual doses would be 2.5 mrem to the public and 3.0 mrem to an uninvolved worker. The dose of 36 person-rem to the off-site population corresponds to 0.018 LCF. Although these accidents represent a low risk of health impacts, accident ID 24, a valve sequence error in the offgas decay system, has been classified as an "anticipated" event by DOE while ID 31 is "extremely unlikely" (Appendix C). As discussed in Section 5.2.9.3.3, the likelihood of accident ID 24 could be reduced by a number of means.

The consequences of all potential accidents, except ID 16, would be four times greater at a power level of 4 MW. The "worst-case" accidents for waste-handling systems (IDs 24 and 31) would correspond to 0.071 LCF in the off-site population. The beyond-design-basis mercury spill (ID 16b) yields maximum individual doses of 590 mrem to the public and 1,100 mrem to an uninvolved worker. The off-site population dose of 8,000 person-rem in this accident corresponds to 4.0 excess LCFs (8,000 person-rem $\times$ 0.0005 LCF/person-rem = 4.0 LCFs). As discussed in Section 5.2.9.2.1, LCF values of 1.0 or greater do not mean that fatalities would actually occur in the off-site population, but they provide a quantified value for use in comparison between alternatives. In addition, there is less than a 1 in 1,000,000 chance that this accident would occur in a given year at the proposed SNS facility.

5.3.9.3.4 Hazardous Materials Accidents

Accidents involving potential exposure to toxic materials are discussed in Section 5.2.9.3.4. All involve spills of irradiated mercury. Accident IDs 2b, 16a, and 16b could result in the OSHA ceiling concentration of 0.1 mg/m^3 being exceeded for a few minutes during the initial stages of these accidents in locations accessible to workers, but it would not be exceeded at or beyond the LANL site boundary. Thus, for only a few minutes at the start of the accident, mercury concentrations at or beyond the site boundary might exceed the TEEL-1 limit (0.075 mg/m^3) but would not exceed the TEEL-2 limit (0.10 mg/m^3); individuals at the boundary at the precise occurrence of the initial emission might perceive an odor, but would not experience or develop irreversible health effects or symptoms that could impair the ability to take protective action.

The second and third stages of these accidents are conservatively assumed to last from 7 to 30 days, while in reality, administrative and emergency response actions would more probably terminate the release in a shorter time period. During these stages, airborne concentrations of mercury would remain two to three orders of magnitude below the TEEL-0 limit of 0.05 mg/m^3, and no observable detrimental effects would be expected to occur.

5.3.10 SUPPORT FACILITIES AND INFRASTRUCTURE

This section summarizes the facilities and infrastructure effects on LANL transportation and utility systems from construction and operation of the proposed SNS.

5.3.10.1 Transportation

As described in Section 3.2.5, Alternative Sites, construction of the proposed SNS, related infrastructure, and support systems would occur at LANL, located in Los Alamos County, in north-central New Mexico approximately 25 miles (40.2 km) from the City of Albuquerque, New Mexico. Only two major roads, State Highway 502 and State Highway 4, access Los Alamos County.

Construction vehicles would access the proposed SNS facility location at the LANL site from State Highway 4 via a new access road. The new access road would be for the exclusive use of the proposed SNS project and would not provide access to other LANL facilities. As such, traffic circulation effects internal to LANL are not expected. Construction employee and vehicle activity would increase during the first years of construction, peaking in the year 2002, and it would decrease significantly during the last year (2004) of construction. The estimated total of 578 construction employees in the peak construction year (2002) is expected to add approximately 466 daily round-trips and 10 material/service trucks to projected site traffic of 6,980 round-trips. This represents a 6 percent increase.

Assumptions used to evaluate the traffic impacts at LANL were based on the location of employment centers relative to the proposed SNS and the existing commuting patterns discussed in Section 4.2.10.1. Approximately 90 percent of construction vehicles would originate from areas east of LANL and travel southbound to the proposed SNS site via State Highway 4; the other 10 percent would access the site from the east on State Highway 4. State Highway 4 is currently a lightly used road. The traffic volume currently experienced on State Highway 4 between the entrance to Bandelier National Monument and State Highway 502 is approximately 1,029 with the peak hr traffic being approximately 154. The average daily trips (ADT) on State Highway 4 between State Highway 501 and the entrance to Bandelier National Monument is approximately 758 vehicle trips. The number of vehicles counted during the peak hr is 114. The expected construction vehicles associated with the proposed SNS would add 857 daily vehicle trips during the peak year of construction (45 percent increase) to the current ADT on State Highway 4 between the entrance to Bandelier National Monument and State Highway 502. An additional 93 daily vehicle trips would occur on State Highway 4 between State Highway 501 and the entrance to Bandelier National Monument (10 percent increase). Some minor traffic effects could be expected from construction of the proposed SNS facility at this location. Construction-related traffic would be near the capacity of State Highway 4 during the peak years of construction.

Operation of the proposed SNS facility would result in an additional 250 resident/visiting scientists by the year 2006, plus another 125 employees during future facility upgrades, such as a second target station. An additional 375 people and 3 service trucks/day (305 round-trips) associated with the proposed SNS project would not be expected to create traffic effects at LANL. Using current site population data (8,655 people) and associated vehicles (6,980) as a measure for comparison, the increase of 305 round-trips (4 percent increase) associated with operation of the proposed SNS facility would be minor.

Table 5.3.10.1-1 compares the No-Action Alternative with the proposed action located at the Los Alamos site. The table provides the percent increase in traffic resulting from the proposed SNS during construction and operation, as compared to the No-Action Alternative. The potential effects of any traffic increases could be reduced by having craft and non-craft workers report to work at different times, thus reducing the adverse effects on traffic flow during rush hours. Additionally, this analysis assumed there would be no transferring of personnel from within LANL. If some of the workers were previously working at LANL, the impact of the traffic would be reduced.

5.3.10.2 Utilities

This section assesses the potential environmental consequences of the proposed SNS for utilities. Although the existing utilities at LANL are extensive, the logistics of using these site services to support the proposed SNS at TA-70 would involve considerable investment in new infrastructure for all services. Since the proposed site at LANL is isolated from central site services, conventional pipeline tie-ins would not be feasible.

5.3.10.2.1 Electricity

The existing electrical power system at LANL does not have adequate capacity for significant future demands and would not meet the additional demands required by the proposed SNS. Also, future electrical distribution would not be reliable because of the age of the system. To supply power for the proposed SNS, DOE would have to pursue several regional and multistate strategies. Some of these strategies would involve bringing a new 115-kV line from the east side of the site. To provide even a 62-MW supply, other strategies in addition to the proposed line would need to be addressed. These include new regional and multistate power grid configurations and perhaps an SNS,

Table 5.3.10.1-1. LANL traffic increases compared to No-Action Alternative.

	Baseline/ No-Action	SNS Construction (Peak Year)	SNS Operation (4 MW)
Passenger Vehicle Trips/Day	6980[a]	466	302
Material Transport Trucks/Day	0	7	0
Service Trucks/Day	0	3	3
Total (% increase)	0 (0%)	476 (6%)	305 (4%)

[a]Based on 8,655 LANL employees.

site-specific, power generation station. Current capacity and reliability limitations of the electric power system would not meet the needs of the proposed SNS; significant upgrades would have to be made to meet those needs.

5.3.10.2.2 Natural Gas

Natural gas would be required to provide energy for operational functions, such as fuel for boilers and localized unit heaters in the facility heating system at the proposed SNS facility. As described in Section 4.2.10.2.2, natural gas capacity would be available to serve the needs of the proposed SNS facility. However, since no existing gas lines or distribution systems are located in the vicinity of the proposed SNS site, an expansion of natural gas infrastructure would be required to serve future needs of the proposed SNS facility. Adequate supplies of natural gas are available; therefore, environmental effects would be limited to expansion of the infrastructure needed to accommodate the proposed SNS.

5.3.10.2.3 Water Service

The proposed SNS would require 1.2 to 2.3 mgpd for the following systems: tower water cooling, deionized cooling, chilled water, building heating, process water, potable water, demineralized water, fire suppression, and target moderators.

As discussed in Section 4.2.10.2.3, based on the current demands of LANL and the surrounding communities (3.3 mgpd), the potable water system with a rated capacity of 3.85 mgpd cannot meet the anticipated demands from future needs, including the needs of the proposed SNS. Accommodating the proposed SNS facility would require delivery system upgrades, including many new lines, lift stations, and storage tanks. Significant water supply effects would be expected with implementation of the proposed SNS facility.

5.3.10.2.4 Sanitary Waste Treatment

While there is sufficient sewage treatment capacity at the existing sanitary waste system in TA-46, the waste would likely have to be trucked to the nearest lift station, located several miles from the proposed SNS site. An alternative would be installing and operating an on-site treatment and discharge system.

5.3.11 WASTE MANAGEMENT

All of the wastes generated during construction and operation of the proposed SNS would be transferred to LANL Waste Operations for processing. The existing waste management systems for hazardous wastes, solid low-level radioactive wastes, and mixed wastes would have sufficient capacity to accommodate the proposed SNS facility's wastes. There would be a minimal effect to the existing sanitary waste treatment and disposal facilities at LANL. The LANL treatment facility for liquid low-level radioactive wastes cannot accommodate wastes with accelerator-produced tritium. Because of LANL's present need for treating LLW with accelerator-produced tritium, a new facility is currently under construction (TA-53 RLW) that will be able to accept this type of waste. This new facility will also be able to handle the additional waste that the SNS facility may generate if built at LANL.

The proposed SNS facility operation and construction projections of waste streams include the following: hazardous waste, LLW, mixed waste, and sanitary/industrial waste, as listed in Table 3.2.3.7-1. A summarization of existing waste management facilities at LANL, along with facility design and/or permitted capacities and remaining available capacities, can be found in Table 5.3.11-1. Projected waste stream forecasts for LANL's individual operations, proposed SNS operations at 4 MW, and the aforementioned wastes are also included in Table 5.3.11-1. Forecasts are projected from 1998 to 2040, unless otherwise noted, and they are based on estimates provided by LANL waste management operations and waste management documentation.

The proposed SNS facility's waste streams would be certified to meet LANL TSD facilities' WAC before wastes would be accepted for TSD at the site. As mentioned earlier in Section 5.2.11, AEA, EPA, and NRC limits for LLLW treatment facility WAC would also need to be addressed for the LANL site. Currently, the LANL Radioactive Liquid Waste Treatment Facility WAC states that the facility will not accept accelerator-produced wastes with tritium for treatment. This criterion exists because the facility does not have equipment in place to treat and remove tritium from water to meet the State of New Mexico Environment Department's NPDES limit of 20,000 pCi/L in the effluent discharged from the facility. Reactor-produced tritium is expected from these requirements by the AEA. The TA-53 RLW, currently under construction, will be able to accept LLLW with accelerator-produced tritium (Moss 1998; LANL 1997a).

As shown in Table 5.3.11-1, no hazardous waste treatment or disposal facilities are located at LANL. LANL hazardous wastes are shipped off-site to DOE-approved licensed commercial facilities for treatment and disposal (LANL 1997b).

LANL waste management facilities provide treatment and disposal of LLW streams. Since facilities are present on-site for treatment and disposition, long-term storage facilities are not necessary on the site (LANL 1997b and 1997f). However, the LLW facilities do not have sufficient capacity to treat the process waste from the proposed SNS if this waste stream were classified as LLLW.

Currently, in accordance with the *LANL Mixed Waste Site Treatment Plan*, LANL ships mixed waste to DOE-approved, off-site licensed commercial treatment and disposal facilities. On-site treatment methods are being developed for processing mixed waste for which there are no commercially available treatment capabilities (LANL 1997e).

LANL has a waste certification process in place to assure wastes meet the WACs for LLW disposal. However, because of the uncertainty of the composition of LLW and mixed wastes that may be generated from operation of the SNS, the waste may not meet the current WAC for waste management facilities at LANL. DOE would take action to assure the proper disposition of these wastes. For example, pretreatment of the waste may assure they meet the WAC. DOE may be able to amend the license at current waste disposal facilities to allow acceptance of wastes from the SNS.

Excess soil, construction wastes, and sanitary wastes would be generated during construction of the proposed SNS facility. Excavated soil and rock would be used for backfill, erosion control, or other environmental purposes. Construction debris would be sent to a Class IV landfill. Liquid sanitary wastes would be transported to the LANL sanitary wastewater treatment plant at LANL. Solid sanitary waste

Table 5.3.11-1. LANL waste management facility description and capacities.

Waste Disposition	Waste Type and Facility	Total Design Capacity for LANL Site	LANL Waste Projections for 1998-2040	Total Remaining Capacity for LANL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998-2040	Potential Effect of Waste Management on the Environment
HAZARDOUS WASTE						
TREATMENT	None					
STORAGE	Liquid/Solid a) TA-54 b) Area L	a) Liquid – 80 m^3 Treatment Tank –5,720 gal b) Solid - 749 m^3	a) 273 m^3/yr b) 669 m^3/yr	Included in Mixed Waste Capacity	Hazardous Liquid 40 m^3	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities. Storage facilities can be expanded via RCRA permit modification.
LOW-LEVEL WASTE						
TREATMENT	Liquid a) RLWTF TA-50 b) TA-53 RLW	a) 25,000 m^3/yr b) 340 m^3/month	a) 21,400 m^3/yr b) 40 m^3/month	a) 4,600 m^3/yr	a) 665 m^3/yr 15,700 m^3/yr Process Waste Potentially LLW	LLW with accelerator-produced tritium will not be accepted for treatment at RLWTF according to WAC. A new facility is under construction. Treatment facilities do not have the capacity to treat the process waste. Facility under construction.
	Solid a) WCRRF b) LA Super Compactor	a) WCRRF - N/A b) Compactor - 200 ton Rating – 6,794 m^3/yr Capacity		5,838 m^3/yr	1,026 m^3/yr	Minimal effect anticipated for waste stream without tritium. No effect anticipated. Waste processed through WCRRF in a batch process. Minimal effect anticipated.

Table 5.3.11-1. LANL waste management facility description and capacities (continued).

Waste Disposition	Waste Type and Facility	Total Design Capacity for LANL Site	LANL Waste Projections for 1998-2040	Total Remaining Capacity for LANL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998-2040	Potential Effect <u>of</u> Waste Management <u>on the Environment</u>
LOW-LEVEL WASTE - continued						
DISPOSAL	<u>Solid</u> TA-54, Area G - Pits 15, 31, 37, 38, 39 <u>Liquid</u> None	150,000 m^3	2,500 m^3/yr	35,000 m^3	1,026 m^3/yr	No effect anticipated. Continued construction of Area G is under evaluation in the LANL Sitewide EIS.
MIXED WASTE						
STORAGE	<u>Liquid</u> TA-54 Area L	1,013 m^3	Combined Liquid/Solid Mixed waste projection at 622 m^3/yr	NA	11 m^3/yr	<u>Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities.</u> Storage facilities can be expanded via RCRA permit modification.
	<u>Solid</u> TA-54 Area G (Dome #49)	1,864 m^3		NA	7 m^3/yr	
SANITARY/INDUSTRIAL WASTE						
TREATMENT	<u>Liquid</u> Sanitary Waste System Consolidation TA-46	1,060,063 m^3/yr	692,827 m^3/yr	368,000 m^3/yr	25,900 m^3/yr	No effect anticipated.
	<u>Solid</u> None					
DISPOSAL	Off-site landfill	NA	5,453 m^3/yr	NA	1,350 m^3/yr	No effect anticipated.

RLWTF - Radioactive Liquid Waste Treatment Facility.
WCRRF - Waste Characterization, Reduction, and Repackaging Facility.
Sources: DOE 1996c; DOE-AL 1998; LANL 1997b; LANL 1997f; LANL 1997e; (n,p) Energy, Inc. and Rogers & Associates 1995.
NA - Not applicable.

would be sent to a sanitary landfill (ORNL 1997b).

As stated in Section 5.2.11, in accordance with the *NSNS Waste Minimization and Pollution Prevention Plan*, considerations for minimizing the production of the proposed SNS facility's waste would be implemented.

5.4 ARGONNE NATIONAL LABORATORY

This section describes the potential environmental effects or changes that would be expected to occur at ANL if the proposed action were to be implemented. Included in the discussion of this section are effects on the physical environment; ecological and biological resources; existing social and demographic environment; cultural, land, and infrastructure resources; and human health.

5.4.1 GEOLOGY AND SOILS

Effects on geology and soils from construction and operation of the proposed SNS facility in the 800 Area at ANL are described in this section.

5.4.1.1 Site Stability

The proposed location for the SNS at ANL is a stable site suitable for construction of the facility. The glacial soils (sand and clays) at ANL would provide adequate foundation support for the proposed facilities. Other large-scale buildings and structures such as the Advanced Photon Source (APS), the Tandem Linac Accelerating System, and the Intense Pulsed Neutron Source have been built at ANL without encountering site stability problems.

5.4.1.2 Seismic Risk

The ANL area is a stable region in terms of seismic activity (refer to Figure 4.3.1.4-1). The closest region of significant seismic occurrences is the New Madrid fault zone along the Missouri-Tennessee border. Ground acceleration from seismic activity at New Madrid would be unlikely to significantly affect the proposed SNS facility at ANL. The proposed SNS would be constructed according to DOE Standard 1020-94 (DOE 1996a). It would be capable of withstanding maximum horizontal ground accelerations of 0.09 gravity for a return period of 500 years, 0.12 gravity for a return period of 1,000 years, 0.15 gravity for a return period of 2,000 years, and 0.26 gravity for a return period of 10,000 years. The SNS beam would be designed to shut down immediately in the event of an earthquake. As such, predictable seismicity for the 800 Area would have no impact on the construction, operation, or retirement of the proposed SNS facility.

5.4.1.3 Soils

Excavation required for construction of the proposed SNS facility would disturb the native soils. Excavated soils would be stockpiled according to soil type and horizon. If the excavated soils possess the proper characteristics, they would be used to construct the shielding berm. Otherwise, the soils would be placed in the spoils area (refer to Section 3.2.5.4). Topsoil removed during excavation would be used for grading and landscaping of the site at the finish of construction.

Construction of the SNS would require removal grading of the site and removal of vegetative cover. As a result, the potential exists for soil erosion and stream siltation especially during periodic storm events. Best management practices would be followed to minimize the impacts of erosion during construction activities. Section 3.2.2.3, Site Preparation, discusses the elements (retention basin, silt fences, temporary storm water drainages, etc.) that would follow an erosion control plan to prevent erosion and siltation of Sawmill Creek on Freund Branch.

Borrow material for construction of the berm covering on the tunnels of the proposed SNS facility would be obtained from excavation of retention ponds and from the creation of replacement wetland areas in the 800 Area (refer to Section 5.4.5.1). Any additional material would be obtained from off-site. The amount of soil required for the proposed SNS facility would not affect available supplies for other uses.

Operations of the proposed SNS at ANL would affect soils within the shielding berm surrounding the linac tunnel (refer to Section 5.2.1.3). Site-specific calculations of nuclide concentrations and transport potential have not been performed for ANL. However, the suite of activation products would not be significantly different from those at ORNL. Downward migration of contaminants at ANL would first encounter an impermeable till stratum primarily composed of clay. Retardation of nuclide migration would occur in this interval, slowing its downward movement into the primary aquifers.

No prime or unique farmlands are present on or in the vicinity of the proposed SNS site at ANL. As a result, the proposed action would have no effects on prime or unique farmlands.

5.4.2 WATER RESOURCES

Effects on water resources from construction and operation of the proposed SNS in the 800 Area at ANL are described in this section. Best management practices would be employed to minimize any effects on surface water due to erosion and siltation during construction (see Section 5.2.1.3).

5.4.2.1 Surface Water

No surface water resources within the ANL reservation would be used to supply potable water for operations at the proposed SNS facility. Demands ranging from 800 to 1,600 gpm (3,028 to 6,057 lpm) would be required to support an SNS facility that may be upgraded throughout its operational life from 1 MW to 4 MW. Potable water is currently piped to ANL from Lake Michigan. Nonpotable water suitable for cooling tower operations is available from the Canal Water Distribution System. Approximately 2 mgpd (7.6 million lpd) of capacity are available for this type of use. No effects on water resources or the distribution system for them are expected from the proposed SNS facility.

Conventional cooling tower blowdown would be discharged into Sawmill Creek, which flows into the Des Plaines River. The average flow in Sawmill Creek in 1996 was 6.7 mgpd (25.4 million lpd). By comparison, a cooling tower discharge rate for a 2-MW facility would add a daily volume of 0.36 mgpd (1.4 million lpd), and a cooling tower discharge rate for a 4-MW facility would add 0.50 mgpd (1.9 million lpd) to the Sawmill Creek flow.

Blowdown would be temporarily held within a retention basin before being released to the surface drainage system. At the conceptual design stage, the size of the retention basin required is estimated at approximately 2 acres (0.81 ha). This basin would be designed to allow sufficient residence time for the discharge to cool to ambient temperatures. If necessary, active cooling systems such as recirculating fountains may be employed. Water released into the northward flowing tributary of Sawmill Creek would exit ANL to an adjacent wetland. Characteristics of the wetlands may be affected due to the increase in flow.

Polyphosphonates for antiscaling and ozone as a biocide would be used in the cooling towers. Discharge from the towers would be regulated to contain about four times the dissolved solids content of potable water (i.e., 1,000 to 1,200 mmhos conductivity). Contributions of solids or chemical agents are not anticipated to significantly affect the stream. Discharge from the cooling towers of the proposed SNS facility would be mixed with other stream flows within ANL and would exit the ANL site at Outfall 001. Discharge at the ANL boundary is monitored under an existing NPDES permit and is required to meet permitted standards.

5.4.2.2 Flood Potential and Floodplain Activities

Executive Order 11988 requires the establishment of procedures to ensure that potential effects of flood hazards and floodplain management are considered for any DOE action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable. Due to the low-lying nature of the area surrounding ANL, few sites are available that allow a facility the size of the proposed SNS to be constructed.

At the proposed SNS site, the eastern edge of the SNS footprint overlies a portion of the 100-yr floodplain of an unnamed tributary to Sawmill Creek. This tributary originates in the 800 Area, connecting to Sawmill Creek north of ANL. In addition, the southern tip of the footprint overlies a portion of the 100-year floodplain of an unnamed tributary to Freund Brook. This tributary originates within the footprint of the proposed SNS and flows southeast to Freund Brook. Its confluence with Freund Brook is outside the footprint of the proposed SNS. The locations of these floodplain areas are shown in Figure 6-1.

Along the unnamed tributary of Sawmill Creek, construction of the proposed SNS would include filling and stabilizing those portions of the floodplains that are required for buildings and related structures. Hence, placement of the proposed SNS facility in the 800 Area location would require an alteration of drainage patterns and construction of storm drains and canals to direct storm flow to the retention basin. There are no high hazard areas, as defined in 10 CFR 1022, within this area of the proposed project. The affected areas are within the ANL boundaries. No private homes or commercial property would be affected by flooding. If the ANL site is selected for construction of the SNS, the drainage pattern of the 800 Area would be altered. The potential effects from this would be minimized by standard construction practices, including optimizing the placement of buildings to avoid the floodplain and the location of the retention basin. The retention basin would be sized to contain a 100-year flood and would serve to control runoff to this tributary and to replace lost capacity to control floodwater due to disruption of the floodplain. Because of the relatively small area of the 100-year floodplain, estimated to be approximately 5 acres (2 ha), that would be affected by construction, compared to the total drainage area of the watershed, and the inclusion of the retention basin to control runoff from the site, no downstream effects on floodplains are predicted from construction of the proposed SNS facility.

During operation of the SNS, 0.36 to 0.5 million gallons of discharge water per day, primarily from the cooling tower, would be discharged to the unnamed tributary of Sawmill Creek. All discharges from the SNS would be directed to the retention basin, thus normalizing the discharge of cooling tower blowdown water and runoff.

Along the unnamed tributary of Freund Brook, construction of the proposed SNS would include filling and stabilizing those portions of the floodplains that are required for buildings and related structures. It would also require an alteration of drainage patterns and construction of storm drains and canals to redirect stormwater flow to Freund Brook. The potential effects of this would be minimized by standard construction practices, including optimizing the placement of buildings to avoid the floodplain. No high hazard areas are located within this area of the proposed project. Because the affected areas are within the ANL boundaries, no private homes or commercial property would be affected by flooding. Less than 1 acre (0.40 ha) of the 100-year floodplain would be affected by construction. Because of its small size compared to the total drainage of the Freund Brook watershed and the early incorporation of drainage features during construction, no downstream effects on floodplains are expected from construction of the proposed SNS facility. Operations at the facility would not affect floodplains in the southern tip of the SNS site or downstream because no SNS cooling water would be discharged into Freund Brook.

Development in the floodplains of DuPage County is regulated by the *DuPage County Countywide Stormwater and Flood Plain Ordinance* (DCSMC and ECD 1998). There is a question of the applicability of these regulations to DOE operations at ANL; however, because of the small area of floodplains involved and the minimal effects that would be expected if ANL is selected for construction of the SNS, DOE expects to be in full compliance with these regulations.

A formal floodplain/wetlands assessment document has been prepared for the proposed action at the ANL site in accordance with the DOE regulations in 10 CFR 1022.12. This document is included as Appendix H of this FEIS.

5.4.2.3 Groundwater

No groundwater resources would be used for construction or operation of the proposed SNS. Over the life of the facility, groundwater has the potential to be affected by leaching and transport of radionuclides from the berm soils (refer to Section 5.2.1.4). However, the potential effects are mitigated at ANL by natural conditions of the site. The uppermost groundwater occurs at a depth of about 65 ft (20 m) from the ground surface within a complex mixture of silts, clays, and sands (Wadsworth Till). The irregular and localized nature of shallow water sources and the extremely low permeability (1×10^{-8} cm/s) of the till renders this formation unusable as a source of drinking water. The primary aquifers for potable water occur at a depth of about 165 ft

(50 m), and the downward rate of water movement through the saturated zone of the till is only about 3 ft/yr (0.9 m/yr). In addition, the high clay content of the till would provide retardation for nuclides. Accurately predicting retardation factors in such a complex environment is difficult, and a complete evaluation of the types and amounts of radionuclides that would be generated in the soils at ANL has not been performed. Groundwater monitoring would be routinely performed (such as on a semiannual or annual basis) to ensure that no migration to the primary aquifers takes place.

5.4.3 CLIMATOLOGY AND AIR QUALITY

Effects on climate and air quality from construction and operation of the proposed SNS facility in the 800 Area at ANL are described in this section.

5.4.3.1 Climatology

Construction and operation of the proposed SNS facility would not affect regional or localized climates within the ANL area.

5.4.3.2 Air Quality

Effects on nonradiological air quality are presented in this section. Airborne radiological releases are evaluated under human health impacts (refer to Section 5.4.9). Construction activities would create temporary effects in regard to particulate matter (PM_{10}) measurements during the construction phase of the proposed SNS facility. This effect would be greatest during early clearing and excavation efforts but would decrease within a relatively short time period. Although no formal estimates of suspended particulate matter have been prepared, this level is predicted to be minimal when weighted over the usual 24-hr averaging period.

The primary nonradiological airborne release during operations at the proposed SNS facility would be combustion products from the use of natural gas. However, steam is available at ANL as an alternative heat source. If the proposed SNS facility were to employ steam heat, its usage would be at a maximum rate of about 60,000 lb/hr against available capacity of 300,000 lb/hr. Peak usage of natural gas would be during the winter months at an approximate rate of 1,447 lb/hr. Emission rates related to the maximum period of natural gas usage are listed in Table 5.3.3.2-1. The proposed SNS site is also considered to be flat, and projected air quality impacts from natural gas usage would be as shown in Table 5.4.3.2-1. Adding maximum background concentrations to maximum projected impacts from sources (a very conservative procedure because the two do not occur at the same location or time) of the proposed SNS facility also does not provide any violations of the NAAQS.

The general conformity rule (40 CFR Part 93) requires the evaluation of potential direct and indirect emissions associated with this project. According to 40 CFR 93.153(h), the project can be presumed to conform to applicable State Implementation Plan provisions if the total of direct and indirect emissions of criteria or precursor pollutant emissions are below rule-specified de minimis levels. Small quantities of direct emissions of particulates and more specifically of the criteria pollutant PM-10 can be anticipated from site preparation activities associated with the construction of project facilities. Indirect emissions can be expected from fuel combustion that will be necessary to meet the anticipated heating needs of the facilities.

Should this location be chosen for construction of the SNS, a formal comparison of site direct and indirect emission rates to the de minimis levels would be made. However, review of anticipated fuel burning hourly emission rates (Table 5.2.3.2-1) indicates, even assuming worst-case (8,760 hr/yr at full capacity) operation, the annual SNS emission rates would be well below the applicable de minimis levels as shown in Table 5.4.3.2-2. PM-10 emissions from construction activities would also be many times less than the 100 tons/yr de minimis level.

Five 200-kW diesel backup generators would be tested for short durations several times a year. Emissions from these generators are rated at 1,450 cfm at 910°F (487°C). Periodic emissions

Table 5.4.3.2-1. Impact of natural gas combustion at the proposed SNS.

NAAQS Compound	Period[a]	Estimate (µg/m³) at 984 ft (300 m)	Maximum Concentration[b]	Assumed Background (µg/m³) (Refer to Table 4.3.3.3-1)	Background + 300 m Location (µg/m³)	NAAQS Limits (µg/m³)
Sulfur dioxide (SO_2)	Annual[c]	0.03	0.05	7.9	7.9	80
	24-hr	0.30	0.60	55.8	56.1	365
	3-hr	0.70	1.40	140.7	141.4	1,300
Carbon monoxide (CO)	8-hr	21	40	2,207	2,228	10,000
	1-hr	30	57	3,602	3,632	40,000
Nitrogen dioxide (NO_2)[d]	Annual[c]	5.0	9.0	61.1	66.1	100
Particulate (PM_{10})	Annual[c]	0.60	1.10	20.0	20.6	50
	24-hr	6.80	13.30	47.0	53.8	150

[a] Factors used to convert from 1-hr averages to long periods taken from EPA 1977.
[b] Concentration at 984 ft (300 m) estimated boundary and maximum concentration [occurring at 174 ft (53 m)] estimated by EPA – Screen 3 Model (v. 96043). Maximum concentration location is expected to be "on-site."
[c] Annual concentrations reflect 33% estimated (conservative) annual usage factor.
[d] Estimated concentration in this table includes all NO_x compounds and not only NO_2 for NAAQS.

Table 5.4.3.2-2. Comparison of worst-case fuel burning emission levels to de minimis levels.

Combustion Product Pollutant	Worst-Case Emissions (tons/yr)	Deminimis Level (tons/yr)
VOCs	0.78	25
NO_x	15.28	25
SO_2	0.09	100
CO	3.20	100
PM-10	1.84	100

from these generator testings would not affect overall air quality, and effects on air quality from the construction or operation of the proposed SNS facility would be negligible.

5.4.4 NOISE

Sound emitted from construction equipment is expected to be temporary and local in nature. This type of noise is specifically exempted from compliance with the Illinois Noise Pollution Control Regulations (IPCD 1973, Rule 208-Exemption). No unusual or significant noise impacts are expected from construction of the proposed SNS facility.

Operations at the proposed SNS facility would generate some noise, caused particularly by site traffic and cooling towers. However, these facilities would be designed to satisfy Illinois State Noise Standards and DOE criteria for occupational safety and health. In general, sound levels would be characteristic of a light industrial setting. Effects on residential areas would be attenuated by the distance from the SNS [>0.4 miles (>0.6 km)] and by the forested buffer zone [at 0 to 0.4 miles (0 to 0.6 km)]. On-site, the level of noise from the proposed SNS facility would be typical of accelerator facilities, and any effects would be negligible when compared to ambient levels.

5.4.5 ECOLOGICAL RESOURCES

This section describes the potential effects construction and operation of the proposed SNS would have on ecological resources in ANL. It includes potential effects on terrestrial and aquatic resources, wetlands, and threatened and endangered species.

5.4.5.1 Terrestrial Resources

For construction of the proposed SNS facility at ANL, 110 acres (45 ha) of land would be cleared of vegetation. A large portion of this area has been disturbed, and its use by wildlife is limited. However, the area in the vicinity of the proposed SNS site has seen little recent disturbance, and the high diversity of habitats in this area supports a large number of wildlife species.

Construction and operation of the proposed SNS facility would reduce wildlife population levels on the proposed SNS site and in adjacent areas over the long term. The Waterfall Glen Nature Preserve may provide a refuge for the displaced wildlife. However, the population levels would be permanently reduced by an amount generally proportional to the amount of habitat lost (Kroodsma 1985, as cited in DOE-CH 1990).

Construction and operation activities and the associated noise and human presence would disturb wildlife occupying areas adjacent to the proposed site. This could result in emigration of some sensitive species from the surrounding area, although many of the species would adjust to the disturbance. To help minimize the disturbance to wildlife, workers would be prevented from entering undisturbed areas delineated before construction.

Except for the fallow deer, the species that would be affected are typical of the surrounding region and are not particularly rare or important as game animals. Generally, these effects on terrestrial biota would be minor.

5.4.5.2 Wetlands

Approximately 3.5 acres (1.4 ha) of wetlands on the proposed SNS site lie within the proposed footprint and would be eliminated by construction activities. This represents approximately 20 percent of the wetlands on and in the vicinity of the proposed SNS site and approximately 7.8 percent of the total area of jurisdictional wetlands on ANL property. All of the alternative sites considered for the SNS contained wetlands and streams; thus, selection of a site that would completely avoid wetland encroachment was not possible. Wetland effects are minimized to the extent that the selected site does not contain either of the two main streams on ANL land and minimizes encroachment on their associated wetlands.

These wetlands provide habitat for area wildlife, such as amphibians and wetland birds. Their primary functions, in addition to provision of wildlife habitat, most likely include flood-flow alteration, nutrient transformation, and organic material production and export. In accordance with Section 404 of the federal Clean Water Act (CWA), a permit from the USACOE would be required for construction in these wetlands. As part of this permit, DOE would consult with the USACOE on plans to mitigate this loss of wetlands. The most common mitigation for destruction of wetlands at ANL is replacement (an equivalent area of wetland habitat created, preferably in the watershed of the impacted wetlands). Because one of the wetlands that would be destroyed is relatively large, approximately 2.7 acres (1.1 ha), it would be difficult to locate a replacement wetland in the same watershed. One possibility that would be investigated would be enhancement of existing wetlands along Freund Brook.

Wetland areas in the vicinity of the proposed SNS site may be affected during construction. Proper construction techniques, including erosion and sedimentation control, would reduce the potential for indirect effects on these wetlands. In consultation with the USACOE, DOE would develop a plan for the protection of these wetlands. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4).

A formal floodplain/wetlands assessment document has been prepared for the proposed action at the ANL site in accordance with the DOE regulations in 10 CFR 1022.12. This document is included as Appendix H of this FEIS.

5.4.5.3 Aquatic Resources

All precipitation runoff from the proposed SNS site would be directed to an approximate 2-acre (0.81-ha) retention basin. Cooling tower blowdown would also be released to this basin. The rate of water discharge from the basin would be up to 350 gpm (1,325 lpm) through a standpipe and into a small tributary of Sawmill Creek. The cooling tower blowdown would be elevated in temperature, and it would contain chemical biocides and antiscaling agents. The source of the makeup water for the SNS cooling towers would be the nonpotable laboratory water system; therefore, the blowdown would not contain chlorine. As described in Chapter 3, the retention basin would be designed to reduce the temperature of the water to the ambient temperature of the receiving stream.

Effluent from the retention basin would eventually be discharged to the small stream in the north end of the proposed SNS site. This stream flows through the Waterfall Glen Nature Preserve and empties into Sawmill Creek, which flows into the Des Plaines River. The addition of this discharge to the base flow of the tributary would increase water flow through the stream channel and associated wetlands. Changes in the biotic community of the tributary may result from this increased flow. Unfortunately, little information about this stream was available for inclusion in the FEIS. Consequently, the potential effects of the effluent discharge of the proposed SNS facility on the tributary could not be described fully. However, because of its location and the fact that Sawmill Creek receives effluents from ANL, the potential effects from the proposed SNS effluents would be expected to be minor.

Freund Brook would receive no operational discharges from the proposed SNS, but construction activities could increase runoff discharge and sediment loading in this stream. Without protection, this could affect the habitat within Freund Brook. Because the substrate of the brook is coarse rock and gravel, the sediments washed into it could settle on the substrate, displacing the current bottom-dwelling fauna. To avoid this potential effect, DOE would establish a 100- to 200-ft (30- to 68-m) buffer zone along Freund Brook. Vegetation within this buffer zone would not be disturbed during construction of the proposed SNS. Erosion control measures, including silt fencing and preservation of native vegetation, would minimize sediment loading in the brook during construction. As a result, effects upon Freund Brook would be minimal.

5.4.5.4 Threatened and Endangered Species

No protected species have been identified on the proposed SNS site at ANL (see Section 4.3.5.4). The great egret, black-crowned night heron, and pied-billed grebe, three state-listed endangered bird species, have been observed in the wetlands southeast of the site. However, these species are not known to breed there or elsewhere in ANL. In addition, these wetlands would not be affected by the proposed SNS project. No other protected species are known to occur in the vicinity of the proposed SNS site. Consequently, no known protected species would be affected by implementation of the proposed action on the SNS site in ANL.

A systematic survey of the proposed SNS site for protected species would be conducted prior to the start of land clearing and construction. Because definitive identification of many protected plants can only be made when they are flowering, this survey would extend over the spring, summer, and fall seasons to maximize the probability of finding them. If found, appropriate mitigation measures would be taken to protect these plants during construction and operation of the proposed SNS facility. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4).

5.4.6 SOCIOECONOMIC AND DEMOGRAPHIC ENVIRONMENT

The socioeconomic impact section identifies whether construction and operation of the proposed project (and associated worker in-migration from outside the ROI) may adversely affect regional services and infrastructure. It also presents an estimate of the financial effects (employment, income, taxes, and economic output) that would be generated locally in the form of worker salaries, indirect effects, and induced effects. Unless otherwise noted, economic effects are described in escalated-year dollars.

The ROI associated with ANL includes Cook, DuPage, Kane, and Will counties, Illinois. This 2,600 mi^2 (6,734 km^2) region was selected because it forms the area within which at least

95 percent of ANL workers currently reside. It is, therefore, the region within which the majority of socioeconomic effects are expected to occur. Socioeconomic effects beyond the ROI are generally expected to be minor.

The total local construction cost is estimated to be approximately $332 million (escalated dollars), and the peak construction year would be 2002, when 578 workers would be on-site (Brown 1998a). Of this total, about three-fourths (433 individuals) would likely be hired from the ROI, and 144 would come from outside the area. An approximate average of 300 SNS workers per year would be employed, including all construction, management, engineering design, and other technical and commissioning staff. Construction of the 1-MW SNS is the bounding case for analysis of construction effects. If the SNS is upgraded to 4 MW, additional construction would occur, but this would be much less than the effects associated with the initial construction of the 1-MW SNS.

Operation of the proposed SNS at 1 MW would begin in 2006 with a staff of 250 persons. Later, if the proposed SNS is upgraded to 4 MW, 375 persons would be employed. The 4-MW case is used for this analysis as the bounding case, and the effects of the proposed 1-MW SNS on the ROI would be similar but slightly less than the 4-MW case.

5.4.6.1 Demographic Characteristics

It is assumed that approximately 75 percent of all construction workers would come from the local region (Brown 1998a). Most of the construction workers would be general craft laborers, and the specialized technical components would be contracted out and fabricated in places not yet known. All locally hired construction workers would commute to the job site from existing residences and would not relocate closer to the site. The experience with past major construction projects has been that most in-migrating workers would temporarily move to the project area but would usually commute home on weekends or periodically. These individuals would generally not bring families to the ROI for the construction period. However, even if all of the in-migrating workers brought families into the ROI, the total (temporary) population increase would be less than 500 persons in the peak year, including spouses and children. This would be a temporary increase in population of much less than 0.01 percent and is, therefore, negligible.

People with the technical expertise needed to operate the proposed SNS facility currently reside in the ROI. However, it is also expected that some plant operators would come from outside the local region. It is assumed that about half of the 375-person operating workforce (for the bounding 4-MW case) would come from outside the area. It is further assumed that these households would be the same size as the national average, because it is not known from where they would in-migrate. It is conservatively estimated that in 2006 the total population increase associated with operations would be about 600 individuals, including spouses and children. The facility operators would be “permanent” residents of the ROI, and little additional in-migration would occur in subsequent years. The population increase associated with construction and operations would represent much less than 0.01 percent of the local population and is, therefore, negligible.

5.4.6.2 Housing

With about 196,000 vacant "dwelling units" (refer to Section 4.3.6.2) in the four-county ROI, workers should easily be able to find apartments to rent or houses to purchase. Some new housing would probably be constructed. However, existing vacancies and historical construction rates indicate that housing would be available for this small in-migration.

5.4.6.3 Infrastructure

Potential effects upon infrastructure are closely tied to population growth. Because the expected permanent in-migration is only 600 individuals, effects on infrastructure would be relatively minor.

There are more than 1,100 schools with an enrollment of 1.7 million students in the ROI. The addition of about 300 children to the ROI would, therefore, be minor. Even if all 300 children attended schools in Kane County, the current teacher-student ration of 1:17 would be unchanged. Effects would also be minor for police and fire protection, health care, and other services.

5.4.6.4 Local Economy

Design of the proposed SNS facility would begin in 1999, and the first construction managers and workers would begin work in FY 2000. The majority of the construction would occur from FY 2001 through FY 2004, with the peak construction employment occurring in FY 2002. Testing of the proposed SNS would be from FY 2003 through FY 2005. Operations are planned to begin by the end of FY 2005; FY 2006 would be the first full year of operations (see Figure 3.2.2-1).

Table 5.4.6.4-1 presents the results of the IMPLAN modeling for the period 1999 through 2006. Economic benefits in the form of jobs, wages, business taxes, and income would begin to accrue during the first year of the project in FY 1999. These economic benefits in the ROI would increase as construction and other associated project activities increase. Design and construction employment would be highest in FY 2002, and there would be an estimated 1,795 total (direct, indirect, and induced) new jobs created at ANL. This trend would begin to diminish in FY 2003 as design and construction employment decreased and would continue to decrease until construction is completed in FY 2004. Facility operations would begin in FY 2005. Operations would reflect substantial regional spending for operator salaries, supplies, utilities, and administrative costs.

The proposed SNS is planned to operate for 40 years. If the level of operation is the same as the 4-MW case measured in the first full year (FY 2006), it is expected that facility operation will continue to support 1,776 jobs each of the following years of operation. Other annual operations effects would include $82.9 million in local wages, $8.7 million in business taxes, $91.2 million in personal income, and $211.3 million in total output

Because of the very large regional population, construction of the facility would not be expected to lower the region's total unemployment rate of 5.2 percent. During operations, the unemployment rate may potentially decrease from 5.2 percent to 5.1 percent. The effects of operating the proposed 1-MW SNS would be similar but slightly lower.

Table 5.4.6.4-1. ANL IMPLAN modeling results—construction and operations impacts.

	1999	2000	2001	2002	2003	2004	2005	2006
Employment								
Direct	115	222	522	634	451	305	42	747
Indirect	88	158	380	475	341	234	32	354
Induced	126	231	551	684	489	334	46	676
Total	328	611	1,452	1,795	1,281	873	120	1,776
Wages								
Direct	$8,288,948	$15,673,685	$38,031,862	$48,011,602	$34,981,555	$24,326,509	$3,405,428	$44,896,760
Indirect	$3,174,669	$5,871,680	$14,351,825	$18,270,892	$13,387,061	$9,361,369	$1,313,399	$15,219,533
Induced	$3,711,096	$6,946,078	$16,868,390	$21,322,235	$15,540,350	$10,810,520	$1,512,284	$22,700,801
Total	$15,174,713	$28,491,443	$69,252,078	$87,604,730	$63,908,966	$44,498,398	$6,231,111	$82,817,092
Business Tax								
Direct	$113,558	$317,964	$701,796	$780,090	$522,183	$332,587	$46,170	$3,322,188
Indirect	$377,034	$702,723	$1,703,248	$2,147,712	$1,561,134	$1,082,963	$151,043	$1,512,655
Induced	$649,948	$1,214,170	$2,942,643	$3,711,773	$2,699,322	$1,873,469	$261,457	$3,915,033
Total	$1,140,540	$2,234,587	$5,347,687	$6,639,575	$4,782,639	$3,289,019	$458,670	$8,749,876
Income								
Direct	$9,303,482	$17,513,984	$42,548,163	$53,794,563	$39,230,485	$27,304,639	$3,822,649	$47,892,968
Indirect	$3,569,229	$6,607,919	$16,167,888	$20,604,452	$15,112,667	$10,579,212	$1,485,821	$17,998,706
Induced	$4,111,446	$7,701,094	$18,715,390	$23,673,539	$17,265,918	$12,018,978	$1,682,444	$25,271,398
Total	$16,984,158	$31,822,997	$77,431,441	$98,072,554	$71,609,070	$49,902,829	$6,990,914	$91,163,074
Output								
Direct	$23,293,804	$44,358,310	$107,435,152	$135,297,745	$98,436,491	$68,359,854	$9,568,254	$103,295,792
Indirect	$8,265,086	$15,431,175	$37,620,415	$47,742,063	$34,913,251	$24,368,507	$3,417,922	$41,430,213
Induced	$10,788,440	$20,221,876	$4,917,774	$62,248,458	$45,430,363	$31,645,379	$4,432,662	$66,623,763
Total	$42,347,330	$80,011,362	$194,233,291	$245,288,267	$178,780,104	$124,373,740	$17,418,838	$211,349,766

Source: IMPLAN Pro.

5.4.6.5 Environmental Justice

As identified in Figures 4.3.6.5-1 and 4.3.6.5-2, minority populations and low-income populations reside within 50 miles (80 km) of the proposed SNS site. For environmental justice effects to occur, there must be high and adverse human health or environmental effects that disproportionately affect minority populations or low-income populations. The human health and safety analyses show that hazardous chemical and radiological releases from normal operations of the proposed SNS facility at 1-MW and 4-MW power levels would be within regulatory limits. Annual radiological doses are given in Section 5.4.9, and the data show that normal air emissions of the proposed 1-MW SNS are negligible and would not result in adverse human health or environmental impacts off-site to the public. Therefore, operation of the proposed SNS would not have disproportionately high and adverse effects on minority or low-income populations.

Radiation doses to the public from both normal operations and accident conditions would not create high and adverse effects. Less than two (1.6) LCFs are calculated at the 4-MW power level over a 40-year operations period. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the calculated number of LCFs could be reduced (refer to Section 5.2.9.2.1). An LCF is a cumulative measure from the entire population (within a 50-mi or 80-km radius) of over 8,000,000 people used for comparing alternatives and does not necessarily indicate that a fatality would occur (refer to Section 5.2.9.2.1). Also, 25 accident scenarios would result in airborne releases. The consequences of most of these accidents would be negligible at power levels of both 1 MW and 4 MW. Four accidents are calculated to induce LCFs in the off-site population. The predominant wind direction is from the south, and wind from the southwest quadrant occurs almost 50 percent of the time (Figure 4.3.3.2-1). Figures 4.3.6.5-1 and 4.3.6.5-2 show a small concentration of minority population to the west of the proposed SNS site, but the site is mostly surrounded by non-minority, higher income population, especially in the path of the predominant wind direction. The public, including minority and low-income persons, could be in the path of an off-site airborne release. However, the analysis has shown that there would not be high and/or adverse effects on any of the population; therefore, there would be no disproportionate risk of significantly high and adverse effects on minority and low-income populations.

A number of uncertainties are associated with the evaluation of potential effects due to subsistence consumption. ANL developed an article reviewing the literature on subsistence consumption (Elliot 1994) and found that (1) ”the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns. At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level”; (2) “a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations”; (3) “the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases the studies were not motivated by minority exposure concerns”; and (4) “the majority populations were not significantly higher than for the population as a whole." Specific data on subsistence living are not available for the ANL region. However, DOE is unaware of any subsistence population residing in the vicinity of the proposed SNS site. Therefore, no adverse effects on such populations are expected.

In order to assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the spring of 1996. The newsletter is available in the public reading rooms. Three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation"; (2) "to provide information about projects and programs at DOE and other Federal and State agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation"; and (3) "to receive relevant information from readers." In addition to the newsletter, DOE has a new project under way to identify what information is being collected on subsistence consumption by other federal agencies and to serve as a clearinghouse for such information (DOE 1996e).

No discharges of radioactive water to surface water would occur because all of the wastes generated during construction and operation of the proposed SNS facility would be transported to ANL for processing. These facilities and the management processes for these wastes are described in Section 5.4.11. All chemical releases would be regulated by NPDES permits and would be in compliance with federal and state regulations. As such, there would be no incremental effects on fish and other edible aquatic life in areas surrounding the proposed SNS site.

The analyses indicate that socioeconomic changes resulting from implementing the proposed SNS would not lead to environmental justice effects. The proposed SNS project would provide economic benefits through generating additional employment and income in the affected region (refer to Table 5.4.6.4-1). There would be increased traffic congestion; however, this effect would not disproportionately affect minority or low-income communities because traffic patterns would not be different between low-income and minority populations and the rest of the surrounding population (refer to Section 5.4.10.1). Overall, nothing from the construction and operation of the proposed SNS would pose high and adverse human health or environmental effects that would disproportionately affect minority or low-income populations.

5.4.7 CULTURAL RESOURCES

The SNS design team has not established the areas where construction or improvement of utility corridors and roads would be necessary to support the proposed SNS at ANL. In addition, the locations of ancillary structures such as a retention basin and a switchyard have not been determined. As a result, the effects of the proposed action on any cultural resources that may occur in these areas cannot be assessed at this time. If the proposed SNS site at ANL were chosen for construction, a cultural resources survey and an assessment of potential effects would be conducted prior to the initiation of construction-related activities in these areas. Appropriate measures would be implemented to mitigate any identified effects on cultural resources. These measures would include avoidance, where possible, or data recovery operations, including detailed recording of surface features and/or archaeological excavation.

5.4.7.1 Prehistoric Resources

No prehistoric archaeological sites have been identified on the proposed SNS site at ANL, but site 11DU207 is located adjacent to the perimeter of the proposed SNS site. This location may result in disturbance or destruction of the site by construction activities from the proposed SNS. Whether or not this would represent an effect on a significant cultural resource is unknown, because the eligibility of this site for listing on the NRHP has not been assessed by ANL. If it is eligible, construction of the proposed SNS may affect a prehistoric cultural resource. If it is not eligible, construction of the proposed SNS would have no effect on prehistoric cultural resources.

The eligibility of 11DU207 for listing on the NRHP would be assessed prior to the initiation of construction-related activities on the proposed SNS site at ANL if this site is selected for construction. If the site is eligible, appropriate measures would be implemented to mitigate effects. These measures would include avoidance, if possible, or archaeological excavation. As a result of these measures, the overall effects of the proposed action on prehistoric cultural resources would be minimal.

5.4.7.2 Historic Resources

Building 829 is the only Historic Period structure remaining in the 800 Area at ANL. This building would be destroyed by site preparation activities under the proposed action. Because this building is not eligible for listing on the NRHP, its destruction would not represent an effect on a cultural resource.

5.4.7.3 Traditional Cultural Properties

DOE Chicago Operations Office (DOE-CH) has found no Native American tribal representatives in the ANL area. Consequently, it has not been possible for DOE-CH to consult with them about the potential occurrence of TCPs on the proposed SNS site and at locations in its immediate vicinity. In addition, no Native American TCPs have been identified in the ANL area, and no Native American groups have expressed an interest in the occurrence and preservation of TCPs at ANL. As a result, it has been concluded that no TCPs occur on the proposed SNS site or anywhere else on laboratory land (White, B. 1998c: 1; Wescott 1998a: 1). Therefore, implementation of the proposed action would have no effect on TCPs.

5.4.8 LAND USE

The potential effects of the proposed action on land use in the vicinity of ANL, within the boundaries of ANL, and on the proposed SNS site are assessed in this section. The assessments cover potential effects on current land uses and zoning for future land use. Furthermore, the potential effects of the proposed action on parklands, nature preserves, major recreational resources, and visual resources are assessed.

5.4.8.1 Current Land Use

Current land use in the area surrounding ANL is driven by the relationship between existing land characteristics and socioeconomic forces acting at the local and regional levels. Similarly, current land use within the ANL boundaries results from selectively using the existing characteristics of the land to meet various DOE mission requirements. The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic land characteristics and other forces that influence land use in these areas. Consequently, implementation of the proposed action on the proposed SNS site in ANL would have no reasonably discernible effects on land use in the vicinity of ANL and throughout most of the laboratory area. However, current uses of the land within and near the proposed SNS site would be more subject to effects.

The current land use designations within the proposed SNS site are Ecology Plots (Nos. 6, 7, and 8), Support Services (minor laboratory support services operations in the 800 Area), and undeveloped Open Space. Furthermore, several contaminated sites are located within the perimeter of the proposed SNS site. They are Area of Concern (AOC) F and Solid Waste Management Units (SWMUs) 170, 736, and 744.

Construction of the proposed SNS facility would introduce large-scale development to areas of previously undeveloped Open Space and Ecology Plot land within the proposed SNS site utility corridors, and rights-of-way. Considering the density of current development at ANL, Ecology Plot and other Open Space land are in relatively short supply (refer to Figure 4.3.8.2-1). Nonetheless, it should be emphasized that ANL has virtually no other types of land for the construction of large-scale facilities.

DOE has a federally mandated role as trustee of the natural and cultural resources on its lands. Although some undeveloped trusteeship lands would be used for the proposed SNS, this use is necessary. Previously developed lands that meet project requirements are not present in sufficient quantities to meet all project needs.

The proposed action would have no effects on the use of land by environmental research projects. The land on and in the vicinity of the proposed SNS site is not being used for environmental research projects. The ecology plots at ANL are areas of land potentially suitable for ecological research. However, little, if any, ecological research has ever been conducted in these areas. There are no currently ongoing ecological research projects in Ecology Plot Nos. 6, 7, and 8 on the SNS site.

Construction of the proposed SNS facility would displace any remaining support services operations in the 800 Area, and it would result in demolition of the remaining buildings and features in this area. The current land use designations for the proposed SNS site would shift to a programmatic category specific to the facility or the Programmatic Mission—Other Areas category. These effects would be minimal, especially considering the long-established pattern of moving support services operations out of the 800 Area and demolishing area buildings.

Extensive earthmoving during construction of the proposed SNS would have the potential to destroy the SWMUs and AOC on the proposed SNS site. SWMUs 176 and 182, located adjacent to the proposed SNS site, could also be affected by these activities. If these areas are not remediated prior to the initiation of construction of the proposed SNS, contamination could be spread to currently uncontaminated areas (refer to Section 5.4.9.1). Realistically, site preparation and other construction activities could not be initiated on the proposed site until current environmental restoration concerns involving these AOCs and SWMUs are adequately addressed. These concerns include continuing characterization, site remediation, and dealing with already established plans to close SWMU 736 (800 Area Transformer Storage Pad) with an impermeable RCRA cap. The prospects for adequately addressing these concerns between the timing of a possible decision to construct the proposed SNS on the selected site in ANL and the scheduled start date for SNS construction remain uncertain. If they cannot be addressed in this time frame, the construction schedule for the proposed SNS would be delayed. If they can be addressed within this time frame, a beneficial effect of the proposed action would be use of a partial brownfield site for a new research facility.

5.4.8.2 Future Land Use

The proposed SNS site is zoned for future use according to the following designations: Programmatic Mission—Other Areas, Programmatic Mission—200 Area, Ecology Plot No. 8, Open Space, and Support Services. Most of the site is within the first two zones, which are dedicated to new research facilities, laboratories, and offices. Operation of the proposed SNS would be consistent with this zoning. It would appear to be inconsistent with using a portion of Ecology Plot No. 8 and the Open Space, but the expansion of other land use zones into areas currently designated as Ecology Plots and Open Space has been a guiding principle behind the current zoning of ANL land. Therefore, use of these areas for the proposed SNS may be viewed as a logical extension of this planning principle. Use of the Support Services zone for the proposed SNS is clearly at variance with current zoning, but this zone is barely within the western boundary of the proposed SNS site. As a result, the amount of Support Services land used for the proposed SNS would be negligible.

Portions of the proposed SNS site would become contaminated with pollutants from operations. Current plans call for in situ decommissioning of the SNS when its operational life cycle is completed. As a result of in situ decommissioning, some contaminated components would remain in place on the SNS site. This could limit the future use of land on the site for other purposes. Construction and operation of the SNS could also limit the future use of land areas adjacent to the SNS site.

No future uses of SNS site and vicinity land for environmental research are planned. This includes the portions of Ecology Plot Nos. 6, 7, and 8 that would be adjacent to the proposed SNS site. As a result, the effects of the proposed action on future research projects cannot be assessed.

5.4.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside ANL and within the laboratory boundaries. Consequently, implementation of the proposed action on the proposed SNS site in ANL would have no reasonably discernible effects on these specific land uses: Forest Preserve District of Cook County (recreation on Saganashkee Slough, McGinnis Slough, and small lakes); hunting and fishing in Sawmill Creek and the Des Plaines River; recreational use of an area adjacent to the southwest boundary of ANL; Waterfall Glen Nature Preserve; and ANL Park.

5.4.8.4 Visual Resources

During construction and operations, the proposed SNS facilities would not be visible from points outside the Waterfall Glen Nature preserve because the preserve is heavily forested. Their close proximity to the west perimeter of ANL, which is adjacent to the nature preserve, would make them visible from points near the ANL fence in the preserve, especially on the west side during late autumn, winter, and early spring. The proposed SNS facilities would be visible from points within the laboratory boundaries. Because the current views at these locations contain buildings and other features characteristic of development, these effects would be minimal.

5.4.9 HUMAN HEALTH

Construction and operation of the proposed SNS at ANL could pose a potential risk of adverse effects on the health of workers and of the public living in the vicinity of the facility. Potential adverse effects include

- Traffic-related fatalities and injuries to workers and the public.
- Occupational fatalities and injuries to workers.
- Exposure of workers and the public to radiation or radioactive materials.
- Exposure of workers and the public to toxic or hazardous materials.

This section evaluates the potential magnitude of these effects at ANL and the likelihood that they would occur during three phases or conditions:

- construction,
- normal operations, and
- accident conditions.

5.4.9.1 Construction

The potential effects on the health of construction workers, other ANL workers, and members of the public would be essentially the same for any of the proposed locations, because the size of the construction work force would be the same. Potential effects of construction of the SNS include construction accidents and traffic accidents.

On the basis of national traffic accident rates (1.74×10^{-8} fatalities per vehicle mile and 1.05×10^{-6} disabling injuries per vehicle mile) and the anticipated total mileage of commuting construction workers (2,074 person-years × 250 work days/person-year × 0.806 daily round-trips/worker × 20 miles/round-trip), less than one additional fatality and nine additional disabling injuries could occur as a result of increased commuter traffic during the 7-year construction period of the proposed SNS.

On the basis of national construction accident rates, 0.31 fatality (0.00015 fatalities/worker-year × 2,074 worker-years) and 110 disabling injuries (0.053 disabling injuries/worker-year × 2,074 worker-years) could occur as a result of occupational accidents during construction of the proposed SNS.

The size of the construction workforce would be the same at all of the proposed locations, and the number of traffic-related disabling injuries and fatalities would be expected to be the same; however, because the existing ANL work force is smaller than at ORNL and LANL, the relative increase would be greater. Based on data in Section 5.4.10.1, a maximum increase of approximately 9 percent could occur from the addition of the SNS construction workers to daily commuter traffic in the vicinity of ANL.

SNS construction workers at ANL would be exposed to the same risk of occupational injury or fatalities as construction workers at the other proposed locations, but ANL workers could be exposed to other additional risks. The preferred site for the proposed SNS at ANL is within the 800 Area (refer to Appendix B). A number of RCRA SWMUs are located within the 800 Area. Several of these SWMUs contain low levels of volatile organic compounds (VOC) and semi-volatile organic compounds and polychlorinated biphenyls (PCBs). Some radioactive materials may also be present. Construction activities such as excavation, grading, and filling could disturb these areas and expose workers to toxic materials.

5.4.9.2 Normal Operations

The number of SNS workers is independent of the location of the facility. The absolute number of industrial accidents and traffic-related injuries and fatalities would be expected to be essentially the same as at the other proposed locations.

On the basis of national traffic accident rates (0.0174 fatalities per million vehicle-mile and 1.05 disabling injuries per million vehicle-mile) and the anticipated total mileage of 60 million miles (375 commuting workers × 20 miles/trip × 0.806 trips/day × 250 days/year × 40 years), 1 additional fatality and 63 additional disabling injuries could occur as a result of increased commuter traffic during the 40-year operational life of the proposed SNS.

National industrial workplace accident rate data applied to the workforce for the proposed SNS would yield less than one fatality (3.4 deaths annually/100,000 workers × 375 workers × 40 years) and 500 disabling injuries (3,400 disabling injuries annually/100,000 workers × 375 workers × 40 years) occurring over the 40-year operational life of the proposed SNS.

The relative increase would be greater at ANL than at ORNL or LANL because ANL's smaller existing work force. Based on data shown in Section 5.4.10.1, the addition of the maximum of 375 SNS workers to the daily ANL traffic flow could increase the number of disabling injuries and fatalities by approximately 6 percent relative to existing rates.

The proposed SNS would generate and release direct radiation, radioactive materials, and toxic materials. Members of the public and workers at the proposed SNS facility and other adjacent facilities would be exposed to such radiation and emissions. The quantities and release rates of these materials would be the same as for other proposed locations. The impact of the ANL site-specific meteorology, distances to site boundaries, and population density and distribution are discussed in the following sections.

5.4.9.2.1 Radiation and Radioactive Emissions

This section assesses the potential effects of direct radiation and airborne emissions of radioactive materials from the proposed SNS based on the methods and dose-to-risk conversion factors discussed in Section 5.1.9.

Direct Radiation

Exposure of SNS workers to direct radiation from the proposed SNS at ANL would be expected to be the same as other proposed locations because the SNS Shielding Design Policy is applicable regardless of location.

The preferred location for the proposed SNS facility at ANL is near existing facilities that emit small amounts of direct radiation. As a result, dose to SNS workers could be slightly higher than under the LANL and ORNL alternatives. The difference, if any, would be on the order of a few mrem. The average total EDE to all ANL workers was 92 mrem in 1996 (DOE 1996f).

The preferred site for the proposed SNS facility at ANL is also relatively close to the site boundary at several points. Based on ANL monitoring results for 1996 that reflect the contributions of direct radiation from several major accelerator facilities (Golchert and Kolzow 1997), the potential increase in direct radiation levels at the ANL boundary, if any, would not be expected to be more than a few mrem/yr.

Radioactive Emissions

Radioactive emissions from routine operations of the proposed SNS would consist of releases to the atmosphere from two stacks—the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack. Radionuclide activities in these emissions are listed in Table G-1 of Appendix G and are the same regardless of the facility location. Existing EPA-permitted commercial disposal facilities servicing ANL have sufficient capacity to accommodate LLLW and process waste from the proposed SNS, and these wastes would be processed in accordance with existing permits for these facilities.

The estimated annual doses to workers and the public from normal SNS airborne emissions are shown in Table 5.4.9.2.1-1. The methods and assumptions used in the calculation of doses are discussed in Section 5.1.9 and in greater detail in Appendix G.

Even under the conservative assumptions regarding the exposure pathways, these estimated doses would be in compliance with applicable regulations. The annual dose to the maximally exposed individual member of the public for operation at a 1-MW beam power (3.2 mrem) is 32 percent of the 10 mrem/yr limit (40 CFR Part 61) that DOE expects the facility to meet, and the maximally exposed individual annual dose for operation at a 4-MW beam power (12 mrem) is 120 percent of the dose. Compliance with 40 CFR Part 61 is determined based on dose at locations actually occupied by people. The maximally exposed individual dose at such locations from existing operations at ANL is very low, only 0.021 mrem in 1996 (Golchert and Kolzow 1997). Because the dose of 12 mrem projected for SNS operations at 4 MW is based on a hypothetical receptor much nearer to the site, ANL would remain in compliance with the addition of emissions from the proposed SNS facility.

Dose at the ANL boundary from emissions from the Tunnel Confinement Exhaust is 0.14 mrem and is dominated by radionuclides in activated concrete dust. Dose at the ANL boundary from emissions from the Target Building Exhaust is dominated by ^{3}H (57 percent) with smaller contributions from ^{14}C, ^{125}I, and ^{203}Hg. These radionuclides are listed in order of decreasing

Table 5.4.9.2.1-1. Estimated annual radiological dose from proposed SNS normal emissions at ANL.[a]

Receptor	1-MW Power Level Target Building[b]	1-MW Power Level Tunnel Confinement[c]	4-MW Power Level Target Building[b]	4-MW Power Level Tunnel Confinement[c]
Maximum Individuals (mrem)				
Off-site Public[d]	3.1	0.14	12	0.12
Uninvolved Workers[d]	0.064	0.056	0.26	0.085
Populations (person-rem)				
Off-site Public[e] (8,176,177 persons)	20	0.13	79	0.13
Uninvolved Workers[e] (3,242 persons)	0.037	0.012	0.15	0.019

[a] Doses shown include the contributions of inhalation, immersion, and "ground shine" for workers and the off-site public and ingestion for the off-site public.
[b] Target Building emissions include hot offgas exhaust, primary confinement exhaust, secondary confinement exhaust from the target building, and activated air from the beam dump buildings.
[c] Tunnel confinement emissions include activated air and concrete dust from the linac tunnel, high-energy beam transport (HEBT) tunnel(s), ring tunnel(s), and ring-to-target beam transport tunnel(s).
[d] The maximally exposed individuals are hypothetical receptors. The member of the public is assumed to occupy a position at the ANL site boundary for 8,760 hr/yr and to produce their entire food supply at this location. The maximally exposed uninvolved worker is assumed to occupy a position within 1.2 miles (2 km) of the stack for 2,000 hr/yr.
[e] The off-site population consists of all individuals residing outside the ANL site boundary within 50 miles (80 km) of the site and is assumed to be present for 8,760 hr/yr. The involved/uninvolved worker population consists of all workers normally within 1.2 miles (2 km) of the facility. These workers are assumed to be present for 2,000 hr/yr.

dose and account for 99 percent of this component of the total individual dose.

To estimate the total consequences from SNS emissions of radioactive materials over the entire life of the facility, annual population dose is multiplied by operating life of the facility and by the dose-to-risk factor of 0.0005 LCFs/ person-rem. For 40 years of operation at 1 MW, 0.4 LCFs would be projected. For 40 years at 4 MW, 1.6 LCFs would be projected. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, 1.3 LCFs would be projected. These projected LCFs do not mean that any actual fatalities would occur as a result of SNS operations but provide a quantified magnitude for comparison to excess LCFs estimated for the other proposed locations.

5.4.9.2.2 Toxic Material Emissions

As discussed in Section 5.2.9.2.2, elemental mercury vapor is the only toxic material expected to be released from the proposed SNS under normal conditions. Based on the continuous annual release rate of 0.0171 mg/s and atmospheric dispersion factors specific to ANL, the maximum mercury concentration in areas that could be occupied by uninvolved workers would be 3.02×10^{-6} mg/m^3 in any 2-hr period and 3.51×10^{-7} mg/m^3 in any 8-hr period. These concentrations are at least

1/100,000th of the OSHA ceiling limit (0.1 mg/m^3) and the ACGIH recommended TLV-TWA (0.05 mg/m^3) for workers. The maximum average annual airborne mercury concentration at the site boundary would be 5.09×10^{-8} mg/m^3, 1/6,000th of the EPA Reference concentration for members of the public (0.0003 mg/m^3).

5.4.9.3 Accident Conditions

This section assesses the affects on human health of accidents that could potentially occur during operation of the proposed SNS at ANL.

5.4.9.3.1 Accident Scenarios

The accident scenarios and source terms for accidents that could potentially occur at the proposed SNS are the same for all alternative sites and are summarized in Table G-2 (refer to Appendix G). The details of these scenarios and source terms are provided in Appendix C. Table 3.2 defines the terminology used to describe the likelihood that a given accident could occur.

5.4.9.3.2 Direct Radiation

The frequencies of occurrence and consequences of accidents involving exposure to direct radiation have not been specifically analyzed. DOE's Shielding Design Policy for the proposed SNS is such that for the worst-case design-basis accident, the dose to the maximally exposed individual in an uncontrolled area would be limited to 1 rem and for a worker in a controlled area would be limited to 25 rem. The risks of this category of accidents would be the same for all proposed sites.

5.4.9.3.3 Radioactive Materials Accidents

DOE has performed a hazard analysis of potential accidents at the proposed SNS, and for those that could result in a release of radioactive material, it has estimated source terms. The DOE analysis is included as Appendix C. Accident scenarios, estimated frequencies of occurrence, and source terms are summarized in Table G-2 and are the same for all proposed SNS alternative sites. The methods used to evaluate the consequences of these accidents are discussed in Section 5.1.9 and in more detail in Appendix G.

Doses for these accidents, should they occur at an SNS facility at ANL, are listed in Table 5.4.9.3.3-1. With the exception of accident ID 16, all doses for accidents at a 4-MW facility would be four times higher than at a 1-MW facility. This is not the case for ID 16, the beyond-design-basis mercury spill, because of differences in the source term model (refer to Exhibit F of Appendix C). At 4 MW (ID 16b), some boiling of mercury is assumed, releasing a larger quantity of mercury than at 1 MW (ID 16a), where only evaporation is assumed.

The pattern of accident doses for the proposed SNS at ANL is similar to that for the other proposed locations. However, doses to individuals reflect the relative proximity of the proposed SNS to the ANL boundary, and population doses reflect the proximity to a major metropolitan area.

At a power level of 1 MW, the beyond-design-basis mercury spill accident (ID 16a) would have the highest dose of the potential accidents

Table 5.4.9.3.3-1. Radiological dose for SNS accident scenarios at ANL.

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	**Event**	**Frequency[b]**	**Source Term[c]**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**
			A. Accidents Involving Proposed SNS Target or Target Components								
2	Major loss of integrity of Hg Target Vessel or piping (Appendix C, Section 3.3)	a) Unlikely	Percent Inventory Mercury Iodine 0.142 0.142	6.7	26.8	3.8	15.2	300	1,200	3.1	12.4
		b) Extremely Unlikely	Percent Inventory Mercury Iodine 0.243 100	21	84	9.0	36.0	1,300	5,200	7.3	29.2
8	Loss of integrity in Target Component Cooling Loop (Appendix C, Section 3.9)	a) Anticipated	Bounded by annual release limits[d]	<10	<10	NA	NA	NA	NA	NA	NA
		b) Anticipated	Gases + Mist + 150 L of D_2O	3.9	15.6	0.31	1.24	32	128	0.18	0.72
		c) Anticipated	18 L of D_2O	0.002	0.008	0.001	0.004	0.057	0.228	0.001	0.004
		d) Anticipated	Gases + Mist + 150 L of H_2O	3.6	14.4	0.27	1.08	13	52	0.15	0.6
16	Beyond-Design-Basis Hg Spill (Appendix C, Section 3.17)	a) Beyond Extremely Unlikely	1 MW Percent Inventory Mercury Iodine 1.11 100	49		28		2,100		22	
		b) Beyond Extremely Unlikely	4 MW Percent Inventory Mercury Iodine 1.28 100		3,100		880		230,000		710

Table 5.4.9.3.3-1. Radiological dose for SNS accident scenarios at ANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam
B. Accidents Involving proposed SNS Waste Systems											
17	Hg Condenser Failure (Appendix C, Section 4.1.1)	Anticipated	13.7 g mercury	0.013	0.052	0.004	0.016	0.6	0.24	0.004	0.016
18	Hg Charcoal Absorber Failure.[e] (Appendix C, Section 4.1.2)	Unlikely	14.8 g mercury	0.004	0.016	0.003	0.012	0.12	0.48	0.002	0.008
19	He Circulator Failure (Appendix C, Section 4.2.1)	Anticipated	1 day tritium production	<0.001	<0.001	<0.001	<0.001	0.012	0.048	0.001	0.001
20	Oxidation of Getter Bed (Appendix C, Section 4.2.2)	Unlikely	1 day tritium production	<0.001	<0.001	<0.001	<0.001	<0.012	0.048	0.001	0.001
21	Combustion of Getter Bed (Appendix C, Section 4.3.1)	Extremely Unlikely	1 year tritium production, 200 g depleted uranium	5.0	20.0	0.94	3.76	430	1,720	0.77	3.08
22	Failure of Cryogenic Charcoal Absorber [f] (Appendix C, Section 4.4.1)	Unlikely	1 day production of xenon	0.21	0.214	0.018	0.072	12	48	0.015	0.06
23	Valve sequence error in Tritium Removal System (Appendix C, Section 4.5.1)	Unlikely	1 year tritium production	4.8	19.2	0.90	3.6	410	1,640	0.74	2.96
24	Valve sequence error in Offgas Decay System (Appendix C, Section 4.5.2)	Anticipated	7 days xenon accumulation (1 decay tank)	14	56	2.3	9.2	1,100	4,400	1.9	7.6

Table 5.4.9.3.3-1. Radiological dose for SNS accident scenarios at ANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	**Event**	**Frequency[b]**	**Source Term[c]**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**
	B. Accidents Involving proposed SNS Waste Systems (continued)										
25	Spill during filling of tanker truck for LLLW Storage Tanks[g] (Appendix C, Section 4.5.3)	Anticipated	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	0.001	0.004	<0.001	<0.001
26	Spray during filling of tanker truck for LLLW[g] (Appendix C, Section 4.5.4)	Anticipated	1.9 ml of LLLW	<0.001	<0.001	<0.001	<0.001	0.003	0.012	<0.001	0.001
27	Spill during filling of tanker truck for Process Waste Storage Tanks[g] (Appendix C, Section 4.5.5)	Anticipated	51,100 L Process Waste to surface water + 57 L to atmosphere	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	
28	Spray during filling of tanker truck for Process Waste[g] (Appendix C, Section 4.5.6)	Anticipated	28.4 L of Process Waste	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	
29	Offgas Treatment pipe break (Appendix C, Section 4.6.1)	Unlikely	24 hrs xenon production	2.2	4.4	0.14	0.56	91	364	0.12	0.48
30	Offgas Compressor Failure (Appendix C, Section 4.6.2)	Unlikely	1 hr xenon production	0.24	0.96	0.017	0.174	14	56	0.015	0.06
31	Offgas Decay Tank Failure (Appendix C, Section 4.6.3)	Extremely Unlikely	7 days xenon accumulation	14	56	2.3	9.2	1,100	4,400	1.9	7.6
32	Offgas Charcoal Filter Failure (Appendix C, Section 4.6.4)	Unlikely	7 days iodine production	0.31	1.24	0.021	0.084	3.4	13.6	0.015	0.06

Table 5.4.9.3.3-1. Radiological dose for SNS accident scenarios at ANL – (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam
B. Accidents Involving proposed SNS Waste Systems (continued)											
33	LLLW System piping failure. (Appendix C, Section 4.6.5)	Unlikely	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	0.001	0.004	<0.001	<0.001
34	LLLW Storage Tank Failure (Appendix C, Section 4.6.6)	Extremely Unlikely	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	0.001	0.004	<0.001	<0.001
37	Process Waste Storage Tank Failure (Appendix C, Section 4.6.9)	Extremely Unlikely	57 L to atmosphere	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	

[a] Unless otherwise indicated, radiological doses are based on radiological source terms for a 1-MW power level and would be four times greater if the facility is operating at 4 MW. These doses are total EDEs and include dose from inhalation and immersion. "Off-site" means outside the site boundary rather than outside the proposed SNS facility boundary. Individual receptors are hypothetical and do not correspond to any actual person. Population receptors are based on the actual number of people residing outside the site boundary and within 50 miles (80 km) of the facility and the number of site workers normally within 1.2 miles (2 km) of the facility and not involved in facility operation.

[b] See Table 5.2.9-2 for the numerical ranges associated with accident frequencies categories.

[c] Source terms are expressed in units that are independent of power level. Except for beyond-design-basis accidents (IDs 16a, 16b), the radioactivity released in accidents at 4 MW is four times that released at 1 MW.

[d] 40 CFR 61 limits dose to members of the public from airborne emissions from DOE facilities to 10 mrem/yr.

[e] Installation of sulfur-impregnated charcoal filters is being considered to serve as a "polishing filter" for the mercury condenser (refer to Event 17).

[f] Cryogenic charcoal absorbers are being considered as an alternative to the offgas compressor, decay storage tanks, and ambient temperature charcoal filters (refer to Events 24, 30, 31, and 32).

[g] Accidents involving tanker trucks may not be applicable for the proposed SNS facility at this site. It has not been determined how LLLW and process waste would be treated and disposed.

[h] Process waste accidental airborne releases occur at ground level. Only atmospheric dispersion factors for elevated releases were calculated for this site. Based on the radionuclide contents of LLLW and process waste source terms and results for ORNL, doses for process waste accidents at this site are anticipated to be approximately 0.001 mrem or less for individuals and to be less than approximately 0.050 person-rem for the off-site population.

NA - Not available.

involving the target. The maximum dose to an individual in the off-site public would be 49 mrem and 28 mrem for the uninvolved worker. The population dose of 2,100 person-rem would correspond to 1.1 excess LCFs. There is less than a one in a million chance that this accident would occur in a given year at the proposed SNS.

At a power level of 1 MW, accidents involving the off-gas decay system (IDs 24 and 31) would result in the highest individual and population doses of any potential accidents involving waste handling systems. The potential dose to the maximally exposed member of the public for these two accidents is 14 mrem and 2.3 mrem for the maximally exposed uninvolved worker. Dose to the maximally exposed member of the public is approximately 5 percent of the 300 mrem/yr received by the average person from natural background. The worker dose is 2.5 percent of the average dose received by workers from normal operations at ANL (DOE 1996f). The population dose of 1,100 person-rem corresponds to 0.5 LCFs. The fact that accident ID 24 is "anticipated" but could easily be mitigated is discussed in Section 5.2.9.3.3

At a power level of 4 MW, the potential consequences of all accidents, except ID 16, would increase by a factor of four. For the "beyond extremely unlikely" mercury spill (ID 16b), dose to the maximally exposed member of the public would be 3,100 mrem and 880 mrem to the maximally exposed uninvolved worker. The dose to the maximally exposed member of the public is slightly more than 10 times the annual dose from natural background radiation and corresponds to a risk of LCF of about 1 in 625 chances (0.0016 LCFs).

The dose to the maximally exposed individuals from the offgas decay system accidents (ID 24 and 31) would be 55 mrem for the public individual, about 20 percent of the annual dose for natural background, and 9.3 mrem for the uninvolved worker.

Because of the large off-site population and the assumptions underlying the use of dose-to-risk factors, the quantified adverse effects are large for four accidents should they occur at a power level of 4 MW. The accident with the greatest potential consequences is the beyond-design-basis mercury spill (ID16b). The population dose of 230,000 person-rem corresponds to 120 LCFs. The probability that this accident would occur in a given year is less than one chance in a million. Another mercury spill accident (ID 2b) also has large quantified adverse health effects in the off-site population. The population dose for this accident of 5,400 person-rem corresponds to 2.7 LCFs. The probability that this "extremely unlikely" accident would occur in a given year is between 1 chance in 10,000 and 1 chance in 1,000,000.

The two accidents involving the offgas decay system (IDs 24 and 31) have the same emission source term and also would have the potential for adverse effects in the off-site population. The population dose of 4,300 person-rem corresponds to 2.1 LCFs. Accident ID 31 is "extremely unlikely," and Accident ID 24 is "anticipated." Section 5.2.9.3.3 discusses several simple actions that could be taken that would reduce the frequency of occurrence of Accident ID 24 to "unlikely."

As discussed in Section 5.2.9.2.1, LCF values of 1.0 or greater do not mean that fatalities would actually occur in the off-site population but provide a quantified value for use in comparison between alternatives.

5.4.9.3.4 Hazardous Materials Accidents

Accidents involving potential exposure to toxic materials are discussed in Section 5.2.9.3.4. All involve spills of irradiated mercury. Accident IDs 2b, 16a, and 16b could result in the OSHA ceiling concentration of 0.1 mg/m^3 being exceeded for a few minutes during the initial stages of these accidents in locations accessible to workers, but it would not be exceeded at or beyond the ANL site boundary. Thus for only a few minutes at the start of the accident, mercury concentrations at or beyond the site boundary might exceed TEEL-1 limit (0.075 mg/m^3) but would not exceed the TEEL-2 limit (0.10 mg/m^3); individuals at the boundary at the precise occurrence of the initial emission might perceive an odor but would not experience or develop irreversible health effects or symptoms that could impair the ability to take protective action.

The second and third stages of these accidents are conservatively assumed to last from 7 to 30 days, while in reality, administrative and emergency response actions would more probably terminate the release in a shorter time period. During these stages, airborne concentrations of mercury would remain two to three orders of magnitude below the TEEL-0 limit of 0.05 mg/m^3, and no observable detrimental effects would be expected to occur.

5.4.10 SUPPORT FACILITIES AND INFRASTRUCTURE

This section summarizes the facilities and infrastructure effects on ANL transportation and utility systems from construction and operation of the proposed SNS.

5.4.10.1 Transportation

As described in Section 3.2.5, Alternative Sites, construction of the proposed SNS, related infrastructure, and support systems would occur at ANL, located in DuPage County, Illinois, approximately 30 miles (48 km) from Chicago. ANL is bordered on the north by I-55, on the east by State Highway 83, and on the south by State Highway 171, which intersects with Lemont Road. Lemont Road runs north-south on the western border of the site.

Approximately 32 miles (51 km) of roadway are present within ANL, including the access roads to Cass Avenue and Lemont Road. The site is accessed via three entrances: the main (North Gate), the West Gate, and the East Gate. Westgate Road is the primary entrance for employees coming from the west. Westgate Road is a two-lane paved road that currently handles mostly automobile traffic with intermittent heavy truck traffic; it is also capable of handling construction traffic. As of 1994, no marked difficulties were apparent for on-site traffic at any location, either during peak periods of arrival and departure or during midday work hours (ANL 1994). Also, according to Illinois DOT standards, vehicle accumulation at intersections and gates is minor, even during peak hours.

In 2002, the population of the ANL site is projected to be 6,800. Only 15 percent (930 people) of current employees participate in carpools; the remainder travel in single-occupant cars (ANL 1994). Using these data, daily vehicle round-trips were calculated to be 6,290. The *1994 Laboratory Integrated Facilities Plan* *for ANL* provides the basis for the population projections in Table 5.4.10.1-1.

The 800 Area is the location within ANL that most closely matches the site for the proposed SNS. The footprint for the proposed SNS at this location, however, overlays Westgate Road. Approximately 1 mile (1.6 km) of the existing Westgate Road would be relocated to the north in order to circumvent the proposed SNS site and replace the existing Westgate Road access. For purposes of this analysis, it is assumed that the relocation of Westgate Road would precede other construction activities, thereby avoiding regular ANL employee traffic into the facility during construction of the proposed SNS. It is further assumed that the “old” Westgate Road would be dedicated to construction vehicles transporting necessary concrete, steel, and related building materials.

Construction employee and vehicular activity would increase during the first years of construction, peaking in 2002, and would decrease significantly during the last year (2004) of construction. The estimated total of 578 construction employees in the peak construction year (2002) is expected to add approximately 466 daily round-trips and 10 material/service trucks to projected site traffic of 6,290 round-trips. This seven percent increase is considered to be below a level of significance and, therefore, would not result in significant short-term (construction) traffic effects on the site and/or adjacent area. However, the nature of the construction vehicles, given their size and speed, would affect traffic composition and may affect the flow of vehicles approaching/exiting the ANL site during construction. The implementation of mitigation measures, as described in Section 5.11, would minimize such adverse effects.

After construction, operation of the proposed SNS would result in an additional 250 resident/visiting scientists by 2006, plus another 125 employees during future facility upgrades, expected approximately 5 years (2011) after operations begin. The long-term total of an additional 375 people and 3 service trucks/day (305 round-trips) is not expected to exceed the *Laboratory Integrated Facilities Plan* projection of approximately 7,500 people in 2011. Therefore, no significant, long-term effects would be expected on the transportation infrastructure from operation of the proposed SNS on the ANL site.

Table 5.4.10.1-2 compares the No-Action Alternative with the proposed action located at the ANL site. The table provides the percentage increase in traffic resulting from the proposed SNS during construction and operation as compared to the No-Action Alternative. The table also provides the percentage increase using existing site data as well as projected data for the site. The potential effects of traffic increases could be reduced by having craft and non-craft workers report to work at different times, thus reducing the adverse effects on traffic flow during rush hours. Additionally, this analysis assumed there would be no transferring of personnel from within ANL. If some of the workers were previously working at ANL, the impact of the traffic would be reduced.

5.4.10.2 Utilities

This section assesses the potential environmental consequences of the proposed SNS on utilities and utility infrastructure at ANL.

Table 5.4.10.1-1. Long-range site population projections.

	1994	1999	2004	2009	2014
ANL	5,700	6,200	6,400	6,800	7,120
DOE	500	500	500	500	500
TOTAL	6,200	6,700	6,900	7,300	7,620

Source: *1994 Laboratory Integrated Facilities Plan for ANL.*

Table 5.4.10.1-2. ANL traffic increases compared to No-Action Alternative.

	Baseline/ No-Action	(Peak Year) SNS Construction	(4 MW) SNS Operation
Passenger vehicle trips[a]/day	6,290	466	302
Material transport trucks/day	0	7	0
Service trucks/day	0	3	3
Total (% increase)	0 (0%)	476 (7%)	305 (5%)

[a]Based on 6,800 ANL employees in 2002.

5.4.10.2.1 Electrical Service

As described in Section 3.2.3.4, the proposed SNS would require large supplies of electrical power for operation. The ANL site's existing 138-kV lines would not be adequate for SNS loads (Fornek 1998a). An actual capacity of 50 MW is available from substation 549A. It is expected that this would be adequate for the 63-MW connected load for the proposed 1-MW SNS. Based on ANL's experience with the APS power requirement estimates, this would probably also satisfy the 4-MW connected case.

The location of the proposed SNS at ANL would require a 6,600-ft (2,012-m) 138-kV overhead line to connect the SNS facility to substation 549A. The route for the 138-kV line would be from substation 549A to Southwood Drive, following Outer Circle Road west to Watertower Road and west to the 800 area. If additional capacity beyond the available 50 MW is required, it would be necessary to coordinate with Commonwealth Edison to determine the best way to provide power to the site. Environmental effects of the proposed SNS on electrical supply are expected to be negligible.

5.4.10.2.2 Steam

The proposed SNS would not necessarily require steam for facility heating, but at ANL heating would be provided by steam. ANL currently uses steam for central heating and steam turbine-driven emergency generators. Approximately 1,500 ft (457 m) of additional steam piping would be required to connect the proposed SNS facility with the current steam distribution system (Fornek 1998a). APS use is approximately 60,000 lb/hr. It is expected that the proposed SNS would use about the same amount. ANL can accommodate approximately 300,000 lb/hr of additional steam demand. Therefore, environmental effects on steam supply from the proposed SNS are expected to be inconsequential.

5.4.10.2.3 Natural Gas

Natural gas would provide energy for operational equipment such as boilers and localized unit heaters in the SNS heating system. As described in Section 4.2.10.2.2, natural gas at ANL is distributed from a nearby, high-pressure main and is used in laboratory areas, boilers, and furnaces not served by the central steam heating system. Natural gas lines at the ANL site are scheduled for upgrade in 1999. It is expected that any capacity increases and/or line extensions associated with the proposed SNS could be incorporated into the upgrade (Fornek 1998a). Thus, effects on natural gas supply and distribution are expected to be minor.

5.4.10.2.4 Water Service

The proposed SNS would require water supplies for the following systems: tower water cooling, deionized cooling, chilled water, building heating, process water, potable water, demineralized water, fire suppression, and target moderators.

The potable domestic water supply at the ANL is purchased from the local water district and is capable of meeting the proposed SNS demand. The remaining capacity of nonpotable water is approximately 2 mgpd (7.6 million lpd) (Fornek 1998a). Estimated peak use of water for the proposed SNS at 1 MW and the fully upgraded facility at 4 MW is expected to be 800 gpm (3,028 lpm) and 1,600 gpm (6,057 lpm), respectively. ANL has adequate existing capacity to treat process wastewater. ANL currently treats 300,000 gpd (1,135,620 lpd) in a treatment system with over a 1-mgpd (3.8-million-lpd) capacity. It is expected that ANL would be able to meet all water requirements for the proposed SNS facility with negligible environmental effects.

5.4.10.2.5 Sewage Treatment

ANL has approximately 500,000 gpd (1,892,700 lpd) of additional sanitary waste capacity. The proposed SNS project would require 12,500 gpd (473,175 lpd) for the 1-MW facility and 18,150 gpd (68,705 lpd) for the fully upgraded 4-MW facility. Therefore, ANL would be able to provide sewage treatment for the proposed SNS. Environmental effects of the proposed SNS on sewage treatment at ANL are expected to be inconsequential.

5.4.11 WASTE MANAGEMENT

All of the wastes generated during construction and operation of the proposed SNS would be transported to ANL for processing. The existing waste management systems at ANL have sufficient capacity to accommodate the proposed SNS waste streams. Additionally, standard DOE practice has been to dispose of hazardous waste at off-site, DOE-approved licensed commercial facilities. Therefore, DOE anticipates only minimal effects on the environment from ANL from waste management activities associated with the SNS.

Projections of construction and operations waste streams that would be generated at the proposed SNS include the following: hazardous waste, LLW, mixed waste, and sanitary/industrial waste, as listed in Table 3.2.3.7-1. A summarization of existing waste management facilities located at ANL, along with facility design and/or permitted capacities and remaining capacities, can be found in Table 5.4.11-1. Waste stream forecasts for ANL's individual operations, the proposed SNS

Table 5.4.11-1. ANL waste management facility description and capacities.

Waste Disposition	Waste Type and Facility	Total Design Capacity for ANL Site	ANL Waste Projections for 1998-2040	Total Remaining Capacity for ANL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projections for 1998-2040	Potential Effect of Waste Management on the Environment
HAZARDOUS WASTE						
TREATMENT	None					
STORAGE	Solid/Liquid a) Bldg. 306 (Central Waste Management Facility) b) Bldg. 325C	Permitted Capacity a) 67 m^3 b) 6 m^3	115 m^3/yr	a) 67 m^3 new facility b) 6 m^3 new facility	40 m^3/yr	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities.
LOW-LEVEL WASTE						
TREATMENT	Liquid a) LLLW Treatment Facility b) Process Waste Treatment Facility (PWTF)	a) LLLW Treatment Facility has two 3.5 m^3/day evaporators. (2,500 m^3/yr) b) PWTF – 1.38E5 m^3/yr	a) LLLWTF 57 m^3/yr b) PWTF 412,600 m^3/yr	a) One 3.5 m^3/day evaporator not currently used. b) 1.0E6 m^3/yr	a) Hazardous Liquid 175,600 gal/yr b) Process Liquid potentially hazardous 4.16E06 gal/yr	a) No effect anticipated. b) No effect anticipated. Tritium discharge would increase from 0.75 Ci/yr to 40 Ci/y.
	Solid Compaction Shredding Facility	Shredder Capacity HEPA filters only, 14 filters/day. Compactor Capacity 50 drums/day	Solid Low-Level Waste Projection at 232 m^3/yr	Capacity can be expanded as necessary	Solid 1,026 m^3/yr	No effect anticipated. Treatment can be extended for greater capacity; personnel resources can be increased.
STORAGE	Solid Area 398	Permitted Capacity 30 m^3	232 m^3/yr	30 m^3	(Not compacted)	No effect anticipated. DOE has contracts in place for disposal of LLW at off-site, DOE-approved licensed commercial facilities.

Table 5.4.11-1. ANL waste management facility description and capacities (continued).

Waste Disposition	Waste Type and Facility	Total Design Capacity for ANL Site	ANL Waste Projections for 1998-2040	Total Remaining Capacity for ANL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projections for 1998-2040	Potential Effect of Waste Management on the Environment
MIXED WASTE						
TREATMENT	Liquid a) Metal Precipitation Filtration Unit b) Chemical/Photo Oxidation Unit c) Mixed Waste Immobilization/ Macro-Encapsulation Unit	Permitted Capacities a) 0.4 m^3/day b) 0.2 m^3/day c) 2 m^3/day	Combined Liquid/Solid Mixed Waste Projection at 9 m^3/yr Combined Liquid/Solid Hazardous Waste Projection at 205 m^3/yr	Capacity can be expanded as necessary	Liquid 10 m^3/yr (approximately 0.04 m^3/yr)	Minimal effects anticipated. Design capacity is much greater than anticipated volumes. If necessary, permitted volumes can be increased. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities.
	Solid a) Alkali Metal Passivation Booth b) Dry Ice Pellet Decontamination unit	Permitted Capacity a) 40 pds/hr b) 500 pds/hr	0.1 m^3/yr 15,000 lb/yr		Solid 7.3 m^3/yr	
STORAGE	Solid/Liquid a) Mixed Waste Storage Facility b) Bldgs. 306, 317; 329, 374A	Permitted Capacity a) 196 m^3 b) 182 m^3	215 m^3/yr		NA	
SANITARY WASTE						
TREATMENT	Liquid Waste Water Treatment Facility	500,000 gpd	350,000 gpd	150,000 gpd	18,000 gpd	No effect anticipated.
DISPOSAL	Solid Off-site landfills	Wastes are transported to DOE approved licensed commercial facilities			1,349 m^3/yr	No effect anticipated.

Sources: DOE-CH 1995; Grandy 1997; Fornek 1998a; Fornek 1998b.
NA - Not applicable.

operations at 4 MW, and the aforementioned wastes are also included in Table 5.4.11-1. These forecasts cover the period from 1998 to 2040, unless otherwise noted. They are based on estimates provided by ANL Waste Management Operations and waste management documentation.

Before wastes from the proposed SNS facility would be accepted for TSD at ANL, they would be certified to meet the WAC of the receiving TSD facility. As mentioned earlier in Section 5.2.11, AEA, EPA, and NRC limits for LLLW treatment facility WAC would also need to be addressed for ANL.

Currently, no hazardous waste treatment or disposal facilities are located at ANL. Hazardous wastes are collected and sent quarterly to a DOE-approved licensed commercial vendor. ANL handles about 30,000 gallons of chemical waste per year, excluding asbestos. The additional 10,800 gallons of hazardous waste generated by the SNS facility would not be a problem for the facility.

No LLW disposal facilities are located at ANL. These wastes are collected, certified, and shipped to off-site, DOE-approved licensed commercial facilities or the DOE Hanford site (Fornek 1998b).

The mixed waste treatment and storage units for ANL are listed in Table 5.4.11-1. Currently, there are no mixed waste disposal facilities at ANL. Mixed wastes are collected and stored on-site pending treatment or shipment. Wastes are stored on-site until an off-site disposal facility can be determined (DOE-CH 1995).

ANL has a waste certification process in place to ensure that wastes meet the WACs for LLW disposal. However, because of the uncertainty of the composition of LLW and mixed wastes that may be generated from operation of the SNS, the waste may not meet the current WAC for waste management facilities at ANL. DOE would take action to ensure the proper disposition of these wastes. For example, pretreatment of the wastes may ensure that they meet the WAC. DOE may be able to amend the license at current waste disposal facilities to allow acceptance of wastes from the SNS.

Excess soil, construction wastes, and sanitary wastes would be generated during construction of the proposed SNS. Excavated soil and rock would be used for backfill, erosion control, or other environmental purposes. Construction debris would be sent to a Class IV landfill. Liquid sanitary wastes would be transported to the ANL sanitary wastewater treatment plant. Solid sanitary waste would be sent to a sanitary landfill (ORNL 1997b).

As stated in Section 5.2.11, in accordance with the *NSNS Waste Minimization and Pollution Prevention Plan*, considerations for minimizing the production of the SNS facility waste would be implemented.

5.5 BROOKHAVEN NATIONAL LABORATORY

This section describes the potential environmental effects or changes that would be expected to occur at BNL if the proposed action were to be implemented. Included in this discussion are the potential effects on the physical environment; ecological and biological resources; the existing social and demographic environment; cultural, land, and infrastructure resources; and human health.

5.5.1 GEOLOGY AND SOILS

Potential effects on geology and soils from construction and operation of the proposed SNS at BNL are described in this section.

5.5.1.1 Site Stability

The proposed SNS site at BNL is stable and would provide excellent foundation support for the SNS. Other large-scale buildings and structures such as the High Flux Beam Reactor (HFBR), the Alternating Gradient Synchrotron, the 200 MeV Linear Accelerator, and the National Synchrotron Light Source have been built at BNL without encountering significant site stability problems. No effects are anticipated from site stability.

5.5.1.2 Seismicity

BNL is in an area of relatively quiet seismic activity (refer to Figure 4.3.1.4-1). The proposed SNS would be constructed at BNL to meet DOE Standard 1020-94 (DOE 1996a) and would be capable of withstanding maximum horizontal ground accelerations of 0.12 gravity for a return period of 500 years, of 0.15 gravity for a return period of 1,000 years, of 0.19 gravity for a return period of 2,000 years, and of 0.30 gravity for a return period of 10,000 years. The particle beam for the proposed SNS facility would be designed to shut down immediately in the event of an earthquake. As such, predictable seismicity at BNL would have no effect on construction, operation, or retirement of the proposed SNS.

5.5.1.3 Soils

Excavation required for construction of the proposed SNS would disturb native soils. Excavated soils would be stockpiled according to soil type and horizon. If the excavated soils possess the proper characteristics, they would be used to construct the shielding berm. Otherwise the soils would be placed in the spoils area (refer to Section 3.2.5.5). Topsoil removed during excavation would be used for grading and landscaping of the site at the finish of construction.

Construction of the SNS would require removal grading of the site and removal of vegetative cover. As a result, the potential exists for soil erosion and stream siltation, especially during periodic storm events. Best management practices would be followed to minimize the impacts of erosion during construction activities. Section 3.2.2.3, Site Preparation, discusses the elements (retention basin, silt fences, temporary storm water drainages, etc.) that would follow an erosion control plan to prevent erosion and siltation of the Peconic River.

The proposed SNS at BNL would most likely be designed with a cut-and-fill approach, providing sufficient amounts of fill material for the shield from within the proposed SNS site. If additional soils are needed, then fill would be obtained from firebreak areas around BNL. Excess spoil material would be stored in the BNL transfer station area. The future supply of fill material would not be affected by construction of the proposed SNS.

Operation of the proposed SNS would affect soils within the shield berm surrounding the linac tunnel (refer to Section 5.2.1.3). Site-specific calculations of nuclide concentrations and transport potential have not been performed for BNL. Importantly, the soils at BNL are primarily composed of quartz sand (SiO_2) and possess little of the retardation capacity normally seen in clay-rich soils or soils with high organic carbon content. The resultant migration rates offer a higher potential for exposure to nuclides. No prime or unique farmlands are present on or in the vicinity of the proposed SNS site at BNL. As a result, the proposed action would have no effects on prime or unique farmlands.

5.5.2 WATER RESOURCES

Potential effects on water resources from construction and operation of the proposed SNS at BNL are described in this section. Best management practices would be employed to minimize any effects on surface water from erosion and siltation during construction (see Section 5.2.1.3).

5.5.2.1 Surface Water

No surface water resources would be used to support operations at the proposed SNS site. Potable water would be supplied by groundwater wells within BNL.

Conventional cooling tower blowdown for the proposed SNS facility would be discharged into the headwaters of the Peconic River. Because there is no sustained flow in this portion of the river, this release would be to the same headwaters reach as the sewage treatment plant (STP). Compared to an average daily contribution of 0.66 mgpd (2.5 million lpd) for the STP, the proposed SNS facility would add about 0.36 to 0.50 mgpd (1.4 to 1.9 million lpd) to the river flow depending upon the facility size (2 or 4 MW). Currently, flow within the headwaters of the Peconic River infiltrates into the subsurface before reaching the boundary of BNL. It is unlikely that the addition of SNS discharge would create sustained off-site flow.

Cooling tower discharges would be temporarily held within an approximate 2-acre (0.81-ha) retention basin before release to the Peconic River. This basin would be designed to allow sufficient residence time for the discharge to cool to ambient temperatures. If necessary, active cooling systems such as recirculating fountains may be employed. Polyphosphonates for antiscaling and ozone as a biocide would be used in the cooling towers. Discharge from the towers would be regulated to contain about four times the dissolved solids content of potable water (i.e., 1,000 to 1,200 mmhos/cm conductivity). Contributions of solids or chemical agents are not anticipated to significantly affect the stream. Flow at the BNL boundary is monitored under an existing NPDES permit and is required to meet permitted standards when it is present. Effects on surface water resources would be expected to be negligible.

5.5.2.2 Flood Potential and Floodplain Activities

The SNS at BNL would not encroach upon the 100-yr floodplain at the Peconic River. Additional flow of 0.36 to 0.50 mgpd (1.36 to 1.9 million lpd) would not affect the delineation of the floodplain within BNL. By comparison, a 1995 project to upgrade the STP would have involved the discharge of 1 mgpd (3.8 million lpd) into the on-site headwaters of the Peconic River. This project received New York State Department of Environmental Conservation (NYSDEC) approval and was found consistent with Executive Order 11988 (Floodplain Management) and all aspects of Executive Order 11990 (Protection of Wetlands). However, the project was eventually reengineered to exclude discharges to the Peconic River. This reengineering was prompted by concerns over the discharge of slightly contaminated groundwater and not floodplain delineation issues (Naidu et al. 1996: 2-45). The project has since been completed with no discharges to the Peconic River.

5.5.2.3 Groundwater

All of Long Island's drinking water supply comes from the Upper Glacial Aquifer, which underlies the island. BNL uses roughly 2,000 gpm (7,570 lpm) of groundwater to meet potable water needs plus heating and cooling requirements. Additional demands of up to 1,600 gpm (6,057 lpm) would be created by the proposed 4-MW SNS facility. Currently, three wells are in the vicinity of the proposed SNS site. Each well is capable of producing approximately 1,200 gpm (4,542 lpm). No effects on the supply or capacity of the water system at BNL are anticipated.

The SNS is proposed to be a high-energy linear accelerator potentially creating more abundant nuclides in the soil than the Alternating Gradient Synchrotron (AGS) Facility. Although transport calculations for BNL have not been performed, characteristics of the groundwater system at BNL would make this site more susceptible than the one at ORNL to effects on groundwater from radionuclide contamination. At the proposed location, the SNS would sit about 20 ft (6.1m) above the groundwater table, if built at natural grade. Using a cut-and-fill approach, the tunnel and ring structures, as well as the activated soils, would be in close proximity to the water table. Because of high permeability, vertical transport rates in these sandy soils can approach 17 ft/yr (5.2 m/yr). Thus, radionuclide contamination of groundwater would be an important potential effect of the proposed SNS facility operations.

At the AGS, only ^{3}H and ^{22}Na have sufficient half-life durations to pose a problem (DOE-BNL 1994b). Calculated dilution reduces exposure estimates to off-site receptors to below levels of concern. If comparable dilution factors can be applied to the SNS releases, then radionuclide concentrations would not be transported off-site at levels of concern. Limited effects may be expected for groundwater quality in the immediate vicinity of the proposed SNS.

Because BNL sits atop a sole source aquifer for Long Island's water supply, the construction of a multilayer shielding berm to reduce nuclide diffusion and migration (refer to Section 3.2.2.9) <u>may be necessary. DOE would conduct site-specific studies at BNL to determine if the alternate shield design would be necessary.</u> In addition, routine groundwater sampling at the proposed SNS facility would be implemented to ensure that radionuclide concentrations are within acceptable limits around the linac tunnel.

5.5.3 CLIMATOLOGY AND AIR QUALITY

Potential effects on the climate and air quality from construction and operation of the proposed SNS at BNL are described in this section.

5.5.3.1 Climatology

Construction and operation of the proposed SNS would not affect regional or localized climates within the BNL area.

5.5.3.2 Air Quality

Impacts on nonradiological air quality are presented in this section. Airborne radiological releases are evaluated under human health impacts (Section 5.5.9). Construction activities would create temporary effects in regard to particulate matter (PM_{10}) measurements during the construction phase of the proposed SNS project. This effect would be greatest during early clearing and excavation efforts but would decrease within a relatively short time period. This level is predicted to be minimal when weighted over the usual 24-hr averaging period.

The primary nonradiological airborne release during operations at the proposed SNS would be combustion products from the use of natural gas. Emission rates related to the maximum period of natural gas usage are listed in Table 5.2.3.2-1. This location is also considered flat, and projected air quality impacts from natural gas usage would be as shown in Table 5.5.3.2-1. Adding maximum background concentrations to maximum projected impacts from the SNS sources (a very conservative procedure because the two do not occur at the same location or time) also does not provide any violations of the NAAQS.

The general conformity rule (40 CFR 93) requires the evaluation of potential direct and indirect emissions associated with this project. According to 40 CFR 93.153(h), the project can be presumed to conform to applicable State

Table 5.5.3.2-1. Impact of natural gas combustion at the proposed SNS.

NAAQS Compound	Period[a]	Estimate (μg/m³) at 984 ft (300 m)	Maximum Concentration[b]	Assumed Background (μg/m³) (Table 4.4.3.3-1)	Background + 300 m Location (μg/m³)	NAAQS Limits (μg/m³)
Sulfur dioxide (SO_2)	Annual[c]	0.03	0.05	—	—	80
	24-hr	0.30	0.60	77.0	77.3	365
	3-hr	0.70	1.40	225.7	226.4	1,300
Carbon monoxide (CO)	8-hr	21	40	6,738	6,759	10,000
	1-hr	30	57	8,016	8,046	40,000
Nitrogen dioxide (NO_2)[d]	Annual[c]	5.0	9.0	49.6	54.6	100
Particulate (PM_{10})	Annual[c]	0.60	1.10	—	—	50
	24-hr	6.80	13.30	57.0	63.8	150

[a] Factors used to convert from 1-hr averages to long periods taken from EPA 1977.
[b] Concentration at 984 ft (300 m) estimated boundary and maximum concentration [occurring at 174 ft (53 m)] estimated by EPA – Screen 3 Model (v. 96043). Maximum concentration location is expected to be "on-site."
[c] Annual concentrations reflect 33% estimated (conservative) annual usage factor.
[d] Estimated concentration in this table includes all NO_x compounds and not only NO_2 for NAAQS.

Implementation Plan provisions if the total of direct and indirect emissions of criteria or precursor pollutant emissions are below rule-specified de minimis levels. Small quantities of direct emissions of particulates and more specifically of the criteria pollutant PM-10 can be anticipated from site preparation activities associated with the construction of project facilities. Indirect emissions can be expected from fuel combustion that will be necessary to meet the anticipated heating needs of the facilities.

Should this location be chosen for construction of the SNS, a formal comparison of site direct and indirect emission rates to the de minimis levels would be made. However, review of anticipated fuel burning hourly emission rates (Table 5.2.3.2-1) indicates, even assuming worst-case (8,760 hr/yr at full capacity) operation, the annual emission rates would be well below the applicable de minimis levels, as shown in Table 5.4.3.2-2. PM-10 emissions from construction activities would also be many times less than the 100 tons/yr de minimis level.

Five 200-kW generators would be tested for short durations several times a year. Emissions from these generators are rated at 1,450 cfm at 910 °F (487 °C). Periodic emissions from these generator testings would not affect overall air quality, and effects on air quality from construction or operation of the proposed SNS facility would be negligible.

5.5.4 NOISE

Noise levels emitted from construction of the proposed SNS at BNL would be very similar to those currently produced by Relativistic Heavy Ion Collider (RHIC) construction. The impacts of construction noise from the proposed SNS facility would be temporary and localized. The proposed SNS would be designed to operate within New York State Noise Standards and DOE criteria for safety and health. No significant noise effects are anticipated from construction of the facility at BNL.

Operations at the proposed SNS facility would generate some noise, caused particularly by traffic and cooling towers. In general, sound levels would be characteristic of a light industrial setting. Impacts to residential areas would be attenuated by the distance from the proposed SNS facility and by existing forested areas. On-site, the level of noise from the proposed SNS facility would be typical of accelerator facilities, and any effects would be negligible when compared to ambient levels.

5.5.5 ECOLOGICAL RESOURCES

This section describes the potential effect construction and operation of the proposed SNS would have on ecological resources at BNL. It includes potential effects on terrestrial and aquatic resources, wetlands, and threatened and endangered species.

5.5.5.1 Terrestrial Resources

Construction of the proposed SNS facility would result in clearing vegetation, primarily oak and pine forest, from 110 acres (45 ha) of land at BNL. The entire proposed SNS site would be cleared during the first year of construction. The timber harvested during site preparation would be sold. Areas not immediately required for construction of proposed SNS facilities would be planted with grasses to minimize erosion.

Wildlife inhabiting the proposed SNS site includes white-tailed deer, gray squirrels, cottontail rabbits, and chipmunks. Construction of the proposed SNS would displace these species to surrounding areas. These areas have ample habitat for the displaced species, but one or more of the species populations may exceed the carrying capacity of the land because new individuals would be added to the existing off-site populations. This effect may result in a small but permanent reduction in these populations.

Clearing operations for construction of the SNS may cause the direct loss of small animals. Also, wildlife would be displaced from cleared areas and the surrounding habitat. Large mammals would be mostly excluded from controlled areas by access control fences. While additional forest-edge habitat would be created, cleared land would represent long-term loss of habitat.

Construction and operation activities and the associated noise and human presence would disturb wildlife occupying areas adjacent to the proposed site. This could result in emigration of some sensitive species from the surrounding area, although many of the species would adjust to the disturbance. To help minimize disturbance to wildlife, construction machinery would be kept in proper operating condition and workers would be prevented from entering undisturbed areas delineated before construction.

The proposed SNS site at BNL lies within the pine barrens area of Long Island, but the 110 acres (45 ha) of land on the site represents less than 2 percent of the legally established Pine Barrens Protection Area. Furthermore, the proposed SNS facility would be constructed entirely within the Compatible Growth Area rather than the more stringently protected Core Preservation Area (refer to Section 4.4.8.4). As a result, construction of the proposed SNS facility would have a minimal effect on the Pine Barrens.

The proposed SNS would operate on land where natural features have been largely removed or altered by construction activities. Consequently, the proposed SNS facility operations would have a minimal effect on terrestrial resources at this location and in immediately adjacent areas. Operation of the SNS would result in emissions to the atmosphere, composed primarily of CO_2, low levels of pollutants (see Section 5.5.3.2), and water vapor. These emissions would have no discernable effects on the surrounding Compatible Growth Area of the protected Pine Barrens.

5.5.5.2 Wetlands

No wetland areas are located within the proposed SNS site. However, three wetland areas are located in the vicinity of the site along the upper reaches of the Peconic River and at some points downstream.

The wetlands associated with the Peconic River would be protected from precipitation runoff and sedimentation during construction of the proposed SNS by establishing an uncleared zone of vegetation between the proposed SNS site and the river and by implementing erosion control measures such as silt fences. As a result, effects on wetland areas along the Peconic River would be minimal.

Runoff from most facilities and blowdown from the cooling towers would be discharged into a retention basin during operations at the proposed SNS. <u>At the conceptual design stage, the size of the retention basin required is estimated at approximately 2 acres (0.81 ha).</u> The outflow from the retention basin would be discharged into the Peconic River at about the same location as the current STP discharge. Therefore, none of the operational discharges from the proposed SNS facility would enter the wetland areas. Wetland areas downstream from the STP outfall would experience an increased flow of water. However, this flow would be less than that caused by a routine rain event. Consequently, construction and operation of the proposed SNS would have minimal effects on wetlands in the vicinity of the proposed SNS site.

5.5.5.3 Aquatic Resources

The proposed SNS site at BNL is adjacent to the headwaters area of the Peconic River. During land clearing and other construction activities, there would be a potential for increased surface water runoff and sediment loading in the river. A minimum 300-ft (91-m) buffer zone of uncleared vegetation would be established between the proposed SNS site and the Peconic River. This undisturbed zone would help limit runoff and preserve the vegetative cover of the river. Also, erosion control measures, including silt fencing and preservation of native vegetation, would be implemented to minimize the increased sediment load flowing to the river during construction. As a result of implementing these measures, effects on aquatic resources in the Peconic River would be minimal.

No effluents would be discharged to the upper reaches of the Peconic River during operation of the proposed SNS. All surface runoff from the site would be directed to the retention basin. Cooling tower blowdown would also be released into this basin. The basin would discharge 350 gpm (1,325 lpm) of water through a standpipe, and the discharge would be piped to the Peconic River. As previously noted, this discharge would empty into the river at about the same location as the current STP discharge. The river channel downstream from the STP outfall would experience an increased flow, but this flow would be less than that caused by a routine rain event. Thus, its effects on aquatic resources would be minimal.

The cooling tower blowdown would be elevated in temperature and contain chemical biocides and antiscaling agents. The source of the make-up water for the cooling towers would be the potable water supply system for the laboratory; therefore, the blowdown would contain chlorine. The blowdown would be dechlorinated prior to its release into the retention basin. As described in Chapter 3, the retention basin would be designed to reduce the temperature of the water to the ambient temperature of the Peconic River prior to discharge.

The foregoing assessment indicates that aquatic resources located on the proposed SNS site and in its vicinity would be minimally affected by the proposed action.

5.5.5.4 Threatened and Endangered Species

Spotted wintergreen, bayberry, and swamp azalea have been identified on the proposed SNS site at BNL (see Section 4.4.5.4). These species are protected under New York Environmental Conservation Law 9-1503 and New York State Regulation 193.3. Prior to the start of construction, DOE would consult with USFWS and the New York Department of Environmental Conservation to develop an appropriate mitigation plan to prevent adverse effects on these protected plants. Possible mitigation measures include placing a fence around the habitat containing protected plants so the construction workers and equipment could not cause damage. Consequently, the proposed action would result in minimal effects on known threatened and endangered species.

A systematic survey for protected species would be conducted in potential habitat areas prior to the start of land clearing and construction activities on the proposed SNS site. Because definitive identifications of many protected plants can only be made when they are flowering, this survey would extend over the spring, summer, and fall seasons to maximize the probability of finding them. If found, appropriate mitigation measures would be taken to protect these plants during construction and operation of the proposed SNS. DOE would include details of the mitigation measures in the MAP (refer to Section 1.4).

5.5.6 Socioeconomic and Demographic Environment

This section identifies whether construction and operation of the proposed project (and associated worker in-migration from outside the ROI) may adversely affect regional services and infrastructure. It also presents an estimate of the financial effects (employment, income, taxes, and economic output) that would be generated locally in the form of worker salaries, indirect effects, and induced effects. Unless otherwise noted, economic effects are described in escalated-year dollars.

The ROI associated with the BNL site includes Nassau and Suffolk Counties, New York. This 1,200-mi^2 region was selected because it forms the area within which at least 90 percent of BNL workers currently reside. It is, therefore, the region within which the majority of socioeconomic impacts are expected to occur. Socioeconomic effects beyond the ROI are generally expected to be minor.

The total local construction cost is estimated to be approximately $332 million (escalated dollars), and the peak construction year would be 2002, when 578 workers will be on-site (Brown 1998a). Of this total, about three-fourths (433 individuals) would likely be hired from the local area, and 144 will come from outside the ROI. An approximate average of 300 workers per year would be on-site, including all construction, management, and engineering design personnel and other technical and commissioning staff. Construction of the 1-MW SNS is the bounding case for analysis of construction effects. If the SNS is upgraded to 4 MW, additional construction would occur but this would be much less than the effects associated with the initial construction of the 1-MW SNS.

Operation of the proposed SNS facility at 1 MW would begin in 2006 with a staff of 250 persons. Later, if the proposed SNS is upgraded to 4 MW, 375 persons would be employed. The 4-MW case is used for this analysis as the bounding case, and the effects of the proposed 1-MW SNS on the ROI would be similar but slightly less than the 4-MW case.

5.5.6.1 Demographic Characteristics

It is assumed that approximately 75 percent of all construction workers would come from the local region (Brown 1998a). Most of the construction workers would be general craft laborers, and the specialized technical components would be contracted out and fabricated in places not yet known. All locally hired construction workers would commute to the job site from existing residences and would not relocate closer to the site. The experience with other past major construction projects has been that most in-migrating workers would temporarily move to the project area but would usually commute home on weekends or periodically. These individuals would generally not bring families to the ROI for the construction period. However, even if all of the in-migrating workers brought families into the ROI, the total (temporary) population increase would be less than 500 persons in the peak year, including spouses and children. This would be a temporary increase in population of much less than 0.01 percent and is, therefore, negligible.

People with the technical expertise needed to operate the proposed SNS facility currently reside in the ROI. However, it is also expected that some plant operators would come from outside the local region. It is assumed that about half of the 375-person operating workforce (for the bounding 4-MW case) would come from outside the area. It is further assumed that these households would be the same size as the national average because it is not known from where they would in-migrate. It is conservatively estimated that in 2006 the total population increase associated with operations would be about 600 individuals, including spouses and children. The facility operators would be "permanent" residents of the area, and little additional in-migration would occur in subsequent years. The population increase associated with construction and operations would represent less than 0.01 percent of the local population and is, therefore, negligible.

5.5.6.2 Housing

With about 71,000 vacant "dwelling units" (refer to Section 4.4.6.2) in the two-county ROI, workers should easily be able to find apartments to rent or houses to purchase. Some new houses would probably be constructed. However, existing vacancies and historical construction rates indicate that housing would be available for this small in-migration.

5.5.6.3 Infrastructure

Potential effects on infrastructure are closely tied to population growth. Because the expected permanent in-migration is only 600 individuals, effects on infrastructure would be relatively minor.

More than 600 schools with an enrollment of 666,000 students are located in the ROI. The addition of less than 300 children to the ROI would, therefore, be minor. Even if all 300 children attended schools in Nassau County, the current teacher-student ration of 1:13 would be unchanged. Effects would also be minor for police and fire protection, health care, and other services.

5.5.6.4 Local Economy

Design of the proposed SNS facility would begin in 1999, and the first construction managers and workers would begin work in FY 2000. The majority of the construction would occur from FY 2001 through FY 2004, with the peak construction employment occurring in FY 2002. Testing of the proposed SNS facility would be from FY 2003 through FY 2005. Operations are planned to begin by the end of FY 2005; FY 2006 would be the first full year of operations (see Figure 3.2.2-1).

Table 5.5.6.4-1 presents the results of the IMPLAN modeling for the period 1999 through 2006. Economic benefits in the form of jobs, wages, business taxes, and income would begin

Table 5.5.6.4-1. BNL IMPLAN modeling results—construction and operations impacts.

	1999	2000	2001	2002	2003	2004	2005	2006
Employment								
Direct	102	202	473	573	404	272	37	678
Indirect	77	139	334	418	300	206	28	362
Induced	90	166	396	491	351	239	33	511
Total	269	507	1,203	1,481	1,055	717	98	1,551
Wages								
Direct	$7,549,066	$14,330,179	$34,733,467	$43,790,913	$31,881,709	$22,154,595	$3,101,162	$39,667,537
Indirect	$2,573,668	$4,754,553	$11,623,660	$14,801,201	$10,845,926	$7,585,138	$1,064,148	$14,888,863
Induced	$2,636,431	$4,961,149	$12,028,197	$15,173,970	$11,045,277	$7,674,012	$1,073,164	$17,016,618
Total	$12,759,165	$24,045,880	$58,385,324	$73,766,084	$53,772,913	$37,413,746	$5,238,474	$71,573,018
Business Tax								
Direct	$186,863	$461,190	$1,047,036	$1,210,987	$833,858	$547,796	$76,291	$4,457,596
Indirect	$451,002	$836,614	$2,032,627	$2,570,126	$1,871,913	$1,301,083	$181,647	$2,070,553
Induced	$597,104	$1,122,175	$2,717,000	$3,422,671	$2,487,629	$1,725,603	$240,913	$3,813,381
Total	$1,234,969	$2,419,979	$5,796,663	$7,203,784	$5,193,400	$3,574,482	$498,852	$10,341,531
Income								
Direct	$8,238,595	$15,629,937	$37,888,677	$47,779,063	$34,789,683	$24,178,269	$3,384,471	$42,795,649
Indirect	$2,996,030	$5,534,549	$13,546,035	$17,270,440	$12,669,442	$8,870,343	$1,245,647	$18,147,646
Induced	$3,016,283	$5,678,937	$13,775,646	$17,387,412	$12,662,937	$8,802,386	$1,231,580	$19,538,272
Total	$14,250,907	$26,843,423	$65,210,358	$82,436,916	$60,122,062	$41,850,998	$5,861,698	$80,481,565
Output								
Direct	$23,274,370	$44,327,898	$107,356,711	$135,192,079	$98,356,752	$68,302,617	$9,560,201	$102,443,763
Indirect	$7,082,311	$13,147,894	$32,089,130	$40,779,464	$29,841,783	$20,841,952	$2,922,516	$42,204,013
Induced	$7,888,100	$14,863,259	$36,082,068	$45,575,617	$33,215,117	$23,104,202	$3,234,652	$51,346,502
Total	$38,244,781	$72,339,050	$175,527,908	$221,547,159	$161,413,653	$112,248,772	$15,717,369	$195,994,276

Source: IMPLAN Pro.

to accrue during the first year of the project in FY 1999. These economic benefits in the ROI would increase as construction and other associated project activities increase. Design and construction employment would be highest in FY 2002, and there would be an estimated 1,481 total (direct, indirect, and induced) new jobs created at BNL. This trend would begin to diminish in FY 2003 as design and construction employment decreased and would continue to decrease until construction is completed in FY 2004. Facility operations would begin in FY 2005. Operations would reflect substantial regional spending for operator salaries, supplies, utilities, and administrative costs.

The proposed SNS is planned to operate for 40 years. If the level of operation is the same as for the 4-MW case measured in the first full year (FY 2006), it is expected that facility operation would continue to support an estimated 1,551 jobs for each of the following years of operation, 873 of which would be indirect or induced. Other annual operations effects would include $71.6 million in local wages, $10.3 million in business taxes, $80.5 million in personal income, and $196 million in total output.

Construction of the facility would create new jobs and may potentially result in the region's unemployment rate dropping from 3.4 percent to 3.3 percent. During operations, the unemployment rate may decrease further to 3.2 percent, depending on whether construction workers and engineers (unemployed following project completion) stay in the ROI. The effects from operating the proposed 1-MW SNS would be similar but slightly lower.

5.5.6.5 Environmental Justice

As identified in Figures 4.4.6.5-1 and 4.4.6.5-2, minority populations and low-income populations reside within 50 miles (80 km) of the proposed SNS site. For environmental justice effects to occur, there must be high and adverse human health or environmental effects that disproportionately affect minority populations or low-income populations.

The human health and safety analyses show that hazardous chemical and radiological releases from normal operation of the proposed SNS at 1-MW and 4-MW power levels would be within regulatory limits. Annual radiological doses are given in Section 5.5.9, and the data show that normal air emissions from the proposed 1-MW SNS would be negligible and would not result in adverse human health or environmental effects on the public at off-site locations. Therefore, operation of the proposed SNS would not have disproportionately high and adverse effects on minority or low-income populations.

Radiation doses to the public from both normal operations and accident conditions would not create high and adverse effects. Less than two (1.5) LCFs are calculated at the 4-MW power level over a 40-year operations period. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, the calculated number of LCFs would be reduced. An LCF is a cumulative measure from the entire regional population (within a 50-mi or 80-km radius) of almost 5,000,000 used for comparing alternatives and does not necessarily indicate that a fatality would occur (refer to Section 5.2.9.2.1). Twenty-five accident scenarios for the proposed SNS at BNL would result in airborne releases. The consequences of most of these accidents would be negligible at power levels of both 1 MW and 4 MW. Four accidents are calculated to result in LCFs at 4 MW. The prevailing ground-level winds are from the southwest during the summer, from the northwest during the winter, and about equal from these two directions in the spring and fall (refer to Figure 4.4.3.2-1). Figures 4.4.6.5-1 and 4.4.6.5-2 show that the closest concentrations of minority and low-income populations are southwest of the proposed site. However, the site is mostly surrounded by non-minority, higher-income populations, especially in the path of the predominant wind direction. The public, including minority and low-income persons, could be in the path of an off-site airborne release. However, the analysis has shown that there would not be high and/or adverse effects on any of the population; therefore, there would be no disproportionate risk of significantly high and adverse effects on minority and low-income populations.

A number of uncertainties are associated with the evaluation of potential effects due to subsistence consumption. ANL developed an article reviewing the literature on subsistence consumption (Elliot 1994) and found that (1) "the majority of the studies that have been conducted to date are focused on site- or region-specific exposure concerns. At present, it is unclear whether the findings of these studies are representative of consumption and exposure levels among minority populations at a national level"; (2) "a large number of risk assessment studies focusing on fish and wildlife consumption examined whole populations without distinguishing between consumption and exposure patterns of specific ethnic (or other) subpopulations"; (3) "the vast majority of studies have focused on fish consumption as an exposure pathway. Few examined wildlife consumption and contamination, and even in such cases the studies were not motivated by minority exposure concerns"; and (4) "the majority populations were not significantly higher than for the population as a whole." Specific data on subsistence living are not available for the BNL region. However, DOE is unaware of any subsistence populations residing in the vicinity of the proposed SNS site. Therefore, no adverse effects on such populations are expected.

In order to assemble and disseminate information on subsistence hunting and fishing, DOE began publishing *A Department of Energy Environmental Justice Newsletter: Subsistence and Environmental Health* in the spring of 1996. The newsletter is available in the public reading rooms. Three goals of the newsletter are (1) "to provide useful information about the health implications of consuming contaminated fish, wildlife, livestock products, or vegetation"; (2) "to provide information about projects and programs at DOE and other Federal and State agencies that address the problems associated with consuming contaminated fish, wildlife, livestock products, or vegetation"; and (3) "to receive relevant information from readers." In addition to the newsletter, DOE has a new project under way to identify what information is being collected on subsistence consumption by other federal agencies and to serve as a clearinghouse for such information (DOE 1996e).

No discharges of radioactive water to surface water would occur because all of the wastes generated during construction and operation of the proposed SNS facility would be transported to BNL facilities for processing. These facilities and the management process for these wastes are described in Section 5.5.11. All chemical releases would be regulated by NPDES permits and would be in compliance with federal and state regulations. As such, there would be no incremental effects on fish or other edible aquatic life in areas surrounding the proposed SNS site.

The analyses indicate that socioeconomic changes resulting from implementing the proposed SNS would not lead to environmental justice effects. The proposed SNS project would provide economic benefits through generating additional employment and income in the affected region (refer to Table 5.5.6.4-1). There would be increased traffic congestion; however, this effect would not disproportionately affect minority or low-income communities because traffic patterns would not be different between low-income and minority populations and the rest of the surrounding population (refer to Section 5.5.10.1). Overall, nothing from construction or operation of the proposed SNS facility would pose high and adverse human health or environmental effects that disproportionately affect minority or low-income populations.

5.5.7 CULTURAL RESOURCES

The potential effects of the proposed action on cultural resources located on and adjacent to the proposed SNS site at BNL are assessed in this section. These assessments involve prehistoric archaeological sites; structures, features, and archaeological sites dating to the Historic Period; and TCPs.

The SNS design team has not established the areas where construction or improvement of utility corridors and roads would be necessary to support the proposed SNS at BNL. In addition, the locations of ancillary structures such as a retention basin and a switchyard have not been determined. As a result, the effects of the proposed action on any cultural resources that may occur in these areas cannot be assessed at this time. If the proposed SNS site at BNL were chosen for construction, a cultural resources survey and an assessment of potential effects would be conducted prior to the initiation of construction-related activities in these areas. Appropriate measures would be implemented to mitigate any identified effects on cultural resources. These measures would include avoidance, where possible, or data recovery operations, including detailed recording of surface features and/or archaeological excavation.

5.5.7.1 Prehistoric Resources

No prehistoric cultural resources have been identified on or adjacent to the proposed SNS site at BNL. Consequently, implementation of the proposed action would have no effect on prehistoric cultural resources listed on or eligible for listing on the NRHP.

5.5.7.2 Historic Resources

Large earthen features such as berms, linear trenches, pits, and mounds have been found at survey Stations 2, 4, 8, and 10 on the proposed SNS site at BNL. These features may have been used for trench warfare training at Camp Upton during World War I. The features at Station 2 may have been a command post associated with adjacent trenches. If these features were associated with World War I training activities, they would date to approximately 1917–1918.

The earthen features at Stations 2, 4, 8, and 10 are considered to be potentially eligible for listing on the NRHP, based on the results of the 1998 cultural resources survey of the proposed SNS site at BNL. All of these features would be destroyed by site preparation activities under the proposed action. These effects would be mitigated through data recovery operations, including detailed recording of surface features and archaeological excavation.

5.5.7.3 Traditional Cultural Properties

No Native American tribal representatives have been identified in the BNL area, and no Native American lands are located on the proposed BNL site. Because no Native American groups have been identified, it has not been possible for DOE to consult with such groups concerning the potential occurrence of TCPs on and near the proposed SNS site. A survey of the proposed site and limited surveys of other areas at BNL have encountered no evidence of prehistoric occupations. In addition, no Native American TCPs have been identified in the BNL area. Based upon these results, it has been concluded that no TCPs occur on the proposed SNS site or anywhere else on laboratory land. Therefore, implementation of the proposed action on the SNS site at BNL would have no effect on such resources.

5.5.8 LAND USE

The potential effects of the proposed action on land use in the vicinity of BNL, within the boundaries of BNL, and on the proposed SNS site are assessed in this section. The assessments cover potential effects on current land uses and zoning for future land use. Furthermore, the potential effects of the proposed action on parklands, nature preserves, major recreational resources, and visual resources are assessed.

5.5.8.1 Current Land Use

Current land use in the area surrounding BNL is driven by the relationship between existing land characteristics and socioeconomic forces acting at the local and regional levels. Similarly, current land use within the boundaries of BNL results from selectively using the existing characteristics of the land to meet various DOE mission requirements. The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic land characteristics and other forces that influence land use. Consequently, implementation of the proposed action on the SNS site at BNL would have no reasonably discernible effects on land use in the vicinity of BNL and throughout most of the laboratory. However, current use of the land within and near the proposed SNS site would be more subject to effects.

The current land use within the proposed SNS site is Open Space. Construction of the proposed SNS facility would introduce development to 110 acres (45 ha) of SNS site land, utility corridors, and rights-of-way. The current use of proposed SNS site land would be changed to Commercial/Industrial. Considering the large areas of undeveloped Open Space that would still be available at BNL (refer to Figure 4.4.8.2-1), these effects would be minimal.

DOE has a federally mandated role as trustee of the natural and cultural resources on its lands. The use of undeveloped trusteeship land for the SNS is proposed only because no previously developed BNL lands that meet project requirements are available.

The land on and in the vicinity of the proposed SNS site is not being used for environmental research projects. As a result, the proposed action would have no effects on the use of land by such projects.

5.5.8.2 Future Land Use

Two versions of zoning for future land use at BNL have been developed. Each is based on the possible construction of a major scientific research facility at the laboratory in the future. One is the muon-muon collider version, and the other is the new linear accelerator version.

As much as 20 percent of the BNL land now used as Open Space is zoned for future Industrial/Commercial use. In the muon-muon collider and new linear accelerator versions, the proposed SNS site is located on land zoned as Open Space and Commercial/Industrial. In each version, most of the land within the proposed SNS site is zoned Commercial/Industrial. Construction and operation of the proposed SNS facility is consistent with this zoning. The use of Open Space would appear to be at variance with this current zoning, but one of the guiding principles behind the zoning of BNL land is to expand other land uses into Open Space.

Portions of the proposed SNS site would become contaminated with pollutants from operations. Current plans call for in situ decommissioning of the SNS when its operational life cycle is completed. As a result of in situ decommissioning, some contaminated components would remain in place on the SNS site. This could limit the future use of land on the site for other purposes. Construction and operation of the SNS could also limit the future use of land areas adjacent to the SNS site.

No future uses of proposed SNS site and vicinity land for environmental research are planned. As a result, effects of the proposed action on specific future research projects cannot be assessed.

The end-use zoning of BNL was completed before the laboratory became an alternative site for the proposed SNS facility. With the exception of a small area of Commercial/Industrial land, the land on the proposed SNS site was zoned for end use as Open Space. However, if the proposed SNS facility were eventually constructed and operated on this site, its presence would probably influence a change of end-use zoning to Commercial/Industrial for both the site and some adjacent land.

5.5.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses in the vicinity of BNL. Consequently, implementation of the proposed action on the proposed SNS site at BNL would have no reasonably discernible effects on the following specific land uses: Brookhaven State Park, Rocky Point State Park, Wildwood State Park, recreational use of the Peconic and Carmens rivers, Calverton Naval Weapons Plant (recreational areas), Cathedral Pines County Park, South Haven County Park, Wertheim National Wildlife Refuge, and Randall Road Hunting Station.

5.5.8.4 Visual Resources

Most of the visual panoramas in the area immediately surrounding BNL and within the laboratory contain features indicative of development. The proposed action would add the SNS facilities to this visual environment, and they would be compatible with it. Consequently, implementation of the proposed action on the proposed SNS site at BNL would have a minimal effect on visual resources.

5.5.9 HUMAN HEALTH

Construction and operation of the proposed SNS at BNL could pose a potential risk of adverse effects on the health of workers and of the public living in the vicinity of the facility. Potential adverse effects include

- Traffic-related fatalities and injuries to workers and the public.
- Occupational fatalities and injuries to workers.
- Exposure of workers and the public to radiation or radioactive materials.
- Exposure of workers and the public to toxic or hazardous materials.

This section evaluates the potential magnitude of these effects and the likelihood that they would occur during three phases or conditions:

- construction,
- normal operations, and
- accident conditions.

5.5.9.1 Construction

The potential effects on the health of construction workers, other BNL workers, and members of the public would be essentially the same for any of the proposed locations, because the size of the construction work force would be the same. Potential effects of construction of the SNS include construction accidents and traffic accidents.

On the basis of national traffic accident rates (1.74×10^{-8} fatalities per vehicle mile and 1.05×10^{-6} disabling injuries per vehicle mile) and the anticipated total mileage of commuting construction workers (2,074 person-years $\times$ 250 work days/person-year $\times$ 0.806 daily round-trips/worker $\times$ 20 miles/round-trip), less than one additional fatality and nine additional disabling injuries could occur as a result of increased commuter traffic during the 7-year construction period of the proposed SNS.

On the basis of national construction accident rates, 0.31 fatality (0.00015 fatalities/worker-year $\times$ 2,074 worker-years) and 110 disabling injuries (0.053 disabling injuries/worker-year $\times$ 2,074 worker-years) could occur as the result of occupational accidents during construction of the proposed SNS.

The existing BNL workforce of 3,100 is smaller than that at the other proposed locations, so the relative increase in traffic-related injuries and fatalities would be greater during construction of the proposed SNS facility at BNL. Based on traffic data shown in Section 5.5.10.1 and the approach described in Section 5.2.9.1, traffic-related disabling injuries and fatalities would be expected to increase by approximately 19 percent during the peak year of construction relative to existing injury and fatality rates at BNL.

No known construction activities or requirements would place SNS construction workers and the public at BNL at a different risk of occupational injury or fatalities than the risk posed to these same groups by construction at any of the proposed locations.

The previous discussion is based on construction of the 1-MW proposed SNS facility. At this stage of design, estimates of the number of workers that would be required to upgrade the facility for 4-MW operation are not available. Because the amount of construction required for upgrade to 4 MW would be less than that required for construction of the original facility, injuries and fatalities for traffic-related and construction accidents for the 4-MW facility would be less than those for construction of the original facility regardless of where the SNS is located.

5.5.9.2 Normal Operations

The number of SNS workers is independent of the location of the facility. The absolute number of industrial accidents and traffic-related injuries and fatalities would be expected to be essentially the same as at the other proposed locations.

On the basis of national traffic accident rates (0.0174 fatalities per million vehicle-mile and 1.05 disabling injuries per million vehicle-mile) and the anticipated total mileage of 60 million miles (375 commuting workers × 20 miles/trip × 0.806 trips/day × 250 days/year × 40 years), 1 additional fatality and 63 additional disabling injuries could occur as the result of increased commuter traffic during the 40-year operational life of the proposed SNS.

National industrial workplace accident rate data applied to the work force for the proposed SNS would yield less than 1 fatality (3.4 deaths annually/100,000 workers × 375 workers × 40 years) and 500 disabling injuries (3,400 disabling injuries annually/100,000 workers × 375 workers × 40 years) occurring over the 40-year operational life of the proposed SNS.

The relative increase would be greater at BNL than at the other proposed locations because of its smaller existing workforce. Based on data shown in Section 5.5.10.1, the addition of the maximum of 375 SNS workers to the daily BNL traffic flow could increase the number of disabling injuries and fatalities in traffic accidents by approximately 12 percent relative to existing rates.

The proposed SNS facility would generate and release direct radiation, radioactive materials, and toxic materials. Members of the public and workers at the proposed SNS facility and other adjacent facilities would be exposed to such radiation and emissions. The quantities and release rates of these materials would be the same as for any of the proposed locations. The impact of the BNL site-specific meteorology, distances to site boundaries, and population density and distribution are discussed in the following sections.

5.5.9.2.1 Radiation and Radioactive Emissions

This section assesses the potential effects of direct radiation and airborne emissions of radioactive materials from the proposed SNS based on the methods and dose-to-risk conversion factors discussed in Section 5.1.9.

<u>Direct Radiation</u>

Exposure of SNS workers to direct radiation from the proposed SNS facility at BNL would be expected to be the same as the other proposed locations because the SNS Shielding Design Policy is applicable regardless of location.

The proposed SNS at BNL is near existing facilities that emit small amounts of direct radiation. As a result, dose to SNS workers at BNL could be slightly different than at the other proposed locations. The difference, if any, would be on the order of a few mrem annually. The average total EDE to all BNL workers was 81 mrem in 1996 (DOE 1996f).

The proposed SNS site at BNL is also relatively close to the site boundary at several points. Based on BNL monitoring results for 1995 that reflect the contributions of direct radiation from several major accelerator facilities (Naidu et al. 1996), the potential increase in direct radiation levels at the BNL boundary, if any, would not be expected to be more than a few mrem/yr.

Radioactive Emissions

Radioactive emissions from routine operations of the proposed SNS facility would consist of releases to the atmosphere from two stacks: the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack. Radionuclide activities in these emissions are listed in Table G-1 of Appendix G and are the same regardless of the facility location. Existing EPA-permitted commercial disposal facilities servicing BNL have sufficient capacity to accommodate LLLW and process waste from the proposed SNS facility, and these wastes would be processed in accordance with existing permits for these facilities.

The estimated annual doses to workers and the public from routine SNS airborne emissions are shown in Table 5.5.9.2.1-1. The methods and assumptions used in the calculation of doses are discussed in Section 5.1.9 and in greater detail in Appendix G.

Even under the conservative assumptions regarding the exposure pathways, these estimated doses would be in compliance with applicable regulations. The dose to the maximally exposed individual member of the public from operation at a 1-MW beam power (0.91 mrem) is 9 percent of the 10-mrem annual limit (40 CFR Part 61) that DOE expects the facility to meet. The maximally exposed individual dose for operation at a 4-MW beam power (3.4 mrem) is 34 percent of the annual dose limit. Because the reported annual dose from existing operations at BNL is very low, only 0.06 mrem to the maximally exposed individual and 3.2 person-rem to the off-site population in 1995 (Naidu et al. 1996), BNL would remain in compliance when the emissions from the proposed SNS are included.

Dose at the BNL boundary because of emissions from the Tunnel Confinement Exhaust is 0.024 mrem and is dominated by radionuclides in activated concrete dust. Dose at the BNL boundary because of emissions from the Target Building Exhaust is dominated by ^{3}H (55 percent) with smaller contributions from ^{14}C, ^{125}I, and ^{203}Hg. These radionuclides are listed in order of decreasing dose and account for 99 percent of this component of the total dose.

To estimate the total consequence from SNS emissions of radioactive materials over the entire life of the facility, annual population dose is multiplied by operating life of the facility and by the dose-to-risk factor of 0.0005 LCFs/ person-rem. For 40 years of operation at 1 MW, 0.4 excess LCFs would be projected. For 40 years at 4 MW, 1.5 excess LCFs would be

Table 5.5.9.2.1-1. Estimated annual radiological dose from proposed SNS normal emissions at BNL.[a]

Receptor	1-MW Power Level Target Building[b]	1-MW Power Level Tunnel Confinement[c]	4-MW Power Level Target Building[b]	4-MW Power Level Tunnel Confinement[c]
Maximum Individuals (mrem)				
Off-site Public[d]	0.89	0.024	3.4	0.029
Uninvolved Workers[d]	0.093	0.050	0.19	0.062
Populations (person-rem)				
Off-site Public[e] (4,940,116 persons)	20	0.41	76	0.41
Uninvolved Workers[e] (2,007 persons)	0.032	0.006	0.096	0.009

[a] Doses shown include the contributions from inhalation, immersion, and "ground shine" for workers and the off-site public and ingestion for the off-site public.

[b] Target Building emissions include hot offgas exhaust, primary confinement exhaust, secondary confinement exhaust from the target building, and activated air from the beam dump buildings.

[c] Tunnel Confinement emissions include activated air and concrete dust from the linac tunnel, high-energy beam transport (HEBT) tunnel(s), ring tunnel(s), and ring-to-target beam transport tunnel(s).

[d] The maximally exposed individuals are hypothetical receptors. The member of the public is assumed to occupy a position at the BNL site boundary for 8,760 hr/yr and to produce their entire food supply at this location. The maximally exposed uninvolved worker is assumed to occupy a position within 1.2 miles (2 km) of the stack for 2,000 hr/yr.

[e] The off-site population consists of all individuals residing outside the BNL site boundary within 50 miles (80 km) of the site and is assumed to be present for 8,760 hr/yr. The involved/uninvolved worker population consists of all workers normally within 1.2 miles (2 km) of the facility. These workers are assumed to be present for 2,000 hr/yr.

projected. If the facility operated for 10 years at 1 MW and 30 years at 4 MW, 1.2 excess LCFs would be projected. These projected excess LCFs do not mean that any actual fatalities would occur as the result of the proposed SNS operations but provide a quantified magnitude for comparison to excess LCFs estimated for the other alternatives.

5.5.9.2.2 Toxic Material Emissions

As discussed in Section 5.2.9.2.2, elemental mercury vapor is the only toxic material expected to be released from the proposed SNS facility under normal conditions. Based on the continuous annual release rate of 0.0171 mg/s and atmospheric dispersion factors specific to BNL, the maximum mercury concentration in areas that could be occupied by uninvolved workers would be 2.71×10^{-6} mg/m^3 in any 2-hr period and 6.05×10^{-7} mg/m^3 in any 8-hr period. These concentrations are at least 1/100,000th of the OSHA ceiling limit (0.1 mg/m^3) and the ACGIH recommended TLV-TWA (0.05 mg/m^3) for workers. The maximum average annual airborne mercury concentration at the site boundary would be 1.60×10^{-8} mg/m^3, 1/20,000th of the EPA Reference concentration for members of the public (0.0003 mg/m^3).

5.5.9.3 Accident Conditions

This section assesses the effects on human health of accidents that could potentially occur during operation of the proposed SNS at BNL.

5.5.9.3.1 Accident Scenarios

The accident scenarios and source terms for accidents that could potentially occur at the proposed SNS are the same for all alternative sites and are summarized in Table G-2 (refer to Appendix G). The details of these scenarios and source terms are provided in Appendix C. Table 3.2 in Appendix C defines the terminology used to describe the likelihood that a given accident could occur.

5.5.9.3.2 Direct Radiation

The frequencies of occurrence and consequences of accidents involving exposure to direct radiation have not been specifically analyzed. DOE's Shielding Design Policy for the proposed SNS is such that for the worst-case design-basis accident, the dose to the maximally exposed individual in an uncontrolled area would be limited to 1 rem and for a worker in a controlled area would be limited to 25 rem. The risks of this category of accidents would be the same for all alternative sites.

5.5.9.3.3. Radioactive Materials Accidents

DOE has performed a hazard analysis of potential accidents at the proposed SNS facility, and for those that could result in release of radioactive material, it has estimated source terms. The DOE analysis is included as Appendix C. Accident scenarios, estimated frequencies of occurrence, and source terms are summarized in Table G-2 and are the same for all proposed SNS alternative sites. The methods used to evaluate the consequences of these accidents are discussed in Section 5.1.9 and in more detail in Appendix G.

Doses for these accidents, should they occur at the proposed SNS facility at BNL, are listed in Table 5.5.9.3.3-1. With the exception of accident ID 16, all doses are for accidents at a 1-MW facility and would be four times higher at a 4-MW facility. This is not the case for ID 16, the beyond-design-basis mercury spill, because of differences in the source term model (refer to Exhibit F of Appendix C). At 4 MW (ID 16b), some boiling of mercury is assumed, releasing a larger quantity of mercury than at 1 MW (ID 16a), where only evaporation is assumed.

The pattern of accident doses for the proposed SNS at BNL is similar to that for the other proposed locations. That is, the same accidents and releases are postulated to occur independent of facility location. However, doses to individuals and populations reflect the relative proximity of the proposed SNS to the BNL boundary, and population doses reflect the proximity to a major metropolitan area.

At a power level of 1 MW, the design-basis mercury spill (ID 16a) has the highest dose of accidents involving the target. The maximum individual doses would be 24 mrem for the maximally exposed individual and 29 mrem for the uninvolved worker. These doses are approximately 10 percent of the 300 mrem received annually by the average person from background radiation. The off-site population dose of 1,500 person-rem corresponds to 0.75 excess LCFs.

At a power level of 1 MW, accidents involving the off-gas decay system (IDs 24 and 31) would

Table 5.5.9.3.3-1. Radiological dose for SNS accident scenarios at BNL.

ID	Event	Frequency[b]	Source Term[c]	Maximum Individual (mrem)[a]				Population (person-rem)[a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
				1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam
A. Accidents Involving Proposed SNS Target or Target Components											
2	Major loss of integrity of Hg Target Vessel or piping (Appendix C, Section 3.3)	a) Unlikely	Percent Inventory Mercury Iodine 0.142 0.142	3.4	13.6	4.0	16.0	210	840	2.9	11.6
		b) Extremely Unlikely	Percent Inventory Mercury Iodine 0.243 100	14	56	9.4	37.6	950	3,800	6.7	26.8
8	Loss of integrity in Target Component Cooling Loop (Appendix C, Section 3.9)	a) Anticipated	Bounded by annual release limits[d]	<10	<10	NA	NA	NA	NA	NA	NA
		b) Anticipated	Gases + Mist + 150 L of D_2O	1.5	6.0	0.26	1.04	1.9	7.6	0.13	0.52
		c) Anticipated	18 L of D_2O	<0.001	0.003	0.001	0.004	0.039	0.156	<0.001	0.004
		d) Anticipated	Gases + Mist + 150 L of H_2O	1.4	5.6	0.22	0.88	4.6	18.4	0.094	0.376
16	Beyond-Design-Basis Hg Spill (Appendix C, Section 3.17)	a) Beyond Extremely Unlikely	1 MW Percent Inventory Mercury Iodine 1.11 100	24		29		1,500		21	
		b) Beyond Extremely Unlikely	4 MW Percent Inventory Mercury Iodine 1.28 100		2,200		920		170,000		660

Table 5.5.9.3.3-1. Radiological dose for SNS accident scenarios at BNL - (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam
	B. Accidents Involving proposed SNS Waste Systems										
17	Hg Condenser Failure (Appendix C, Section 4.1.1)	Anticipated	13.7 g mercury	0.007	0.028	0.005	0.02	0.41	1.64	0.003	0.012
18	Hg Charcoal Absorber Failure.[e] (Appendix C, Section 4.1.2)	Unlikely	14.8 g mercury	0.002	0.008	0.003	0.012	0.077	0.308	0.002	0.008
19	He Circulator Failure (Appendix C, Section 4.2.1)	Anticipated	1 day tritium production	<0.001	<0.001	<0.001	<0.001	0.009	0.036	<0.001	<0.001
20	Oxidation of Getter Bed (Appendix C, Section 4.2.2)	Unlikely	1 day tritium production	<0.001	<0.001	<0.001	<0.001	<0.009	0.036	<0.001	<0.001
21	Combustion of Getter Bed (Appendix C, Section 4.3.1)	Extremely Unlikely	1 year tritium production, 200 g depleted uranium	4.0	16.0	0.99	3.96	320	1,280	0.71	2.84
22	Failure of Cryogenic Charcoal Absorber [f] (Appendix C, Section 4.4.1)	Unlikely	1 day production of xenon	0.13	0.52	0.019	0.076	8.0	32.0	0.014	0.056
23	Valve sequence error in Tritium Removal System (Appendix C, Section 4.5.1)	Unlikely	1 year tritium production	3.8	15.2	0.95	3.8	300	1,200	0.68	2.72
24	Valve sequence error in Offgas Decay System (Appendix C, Section 4.5.2)	Anticipated	7 days xenon accumulation (1 decay tank)	10	40	2.4	9.6	770	3,080	1.7	6.8

Table 5.5.9.3.3-1. Radiological dose for SNS accident scenarios at BNL - (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	Event	Frequency[b]	Source Term[c]	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam	1 MW Beam	4 MW Beam
B. Accidents Involving proposed SNS Waste Systems (continued)											
25	Spill during filling of tanker truck for LLLW Storage Tanks[g] (Appendix C, Section 4.5.3)	Anticipated	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
26	Spray during filling of tanker truck for LLLW[g] (Appendix C, Section 4.5.4)	Anticipated	1.9 ml of LLLW	<0.001	<0.001	<0.001	<0.001	0.002	0.008	<0.001	0.001
27	Spill during filling of tanker truck for Process Waste Storage Tanks[g] (Appendix C, Section 4.5.5)	Anticipated	51,100 L Process Waste to surface water + 57 L to atmosphere	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	
28	Spray during filling of tanker truck for Process Waste[g] (Appendix C, Section 4.5.6)	Anticipated	28.4 L of Process Waste	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	
29	Offgas Treatment pipe break (Appendix C, Section 4.6.1)	Unlikely	24 hrs xenon production	1.6	6.4	0.15	0.6	4.7	18.8	0.12	0.48
30	Offgas Compressor Failure (Appendix C, Section 4.6.2)	Unlikely	1 hr xenon production	0.23	0.92	0.019	0.076	7.4	29.6	0.015	0.06
31	Offgas Decay Tank Failure (Appendix C, Section 4.6.3)	Extremely Unlikely	7 days xenon accumulation	10	40	2.4	9.6	770	3,080	1.7	6.8
32	Offgas Charcoal Filter Failure (Appendix C, Section 4.6.4)	Unlikely	7 days iodine production	0.15	0.6	0.020	0.080	1.5	6.0	0.012	0.0048

Table 5.5.9.3.3-1. Radiological dose for SNS accident scenarios at BNL - (continued).

				Maximum Individual (mrem) [a]				Population (person-rem) [a]			
				Off-site Public		Uninvolved Workers		Off-site Public		Uninvolved Workers	
ID	**Event**	**Frequency[b]**	**Source Term[c]**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**	**1 MW Beam**	**4 MW Beam**
B. Accidents Involving proposed SNS Waste Systems (continued)											
33	LLLW System piping failure. (Appendix C, Section 4.6.5)	Unlikely	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
34	LLLW Storage Tank Failure (Appendix C, Section 4.6.6)	Extremely Unlikely	0.00005% of contents of LLLW Tank	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001
37	Process Waste Storage Tank Failure (Appendix C, Section 4.6.9)	Extremely Unlikely	57 L to atmosphere	See footnote "h"		See footnote "h"		See footnote "h"		See footnote "h"	

[a] Unless otherwise indicated, radiological doses are based on radiological source terms for a 1-MW power level and would be four times greater if the facility is operating at 4 MW. These doses are total EDEs and include dose from inhalation and immersion. "Off-site" means outside the site boundary rather than outside the proposed SNS facility boundary. Individual receptors are hypothetical and do not correspond to any actual person. Population receptors are based on the actual number of people residing outside the site boundary and within 50 miles (80 km) of the facility and the number of site workers normally within 1.2 miles (2 km) of the facility and not involved in facility operation.

[b] Refer to Table 5.2.9-2 for the numerical ranges associated with accident frequencies categories.

[c] Source terms are expressed in units that are independent of power level. Except for beyond-design-basis accidents (IDs 16a, 16b), the radioactivity released in accidents at 4 MW is four times that released at 1 MW.

[d] 40 CFR 61 limits dose to members of the public from airborne emissions from DOE facilities to 10 mrem/yr.

[e] Installation of sulfur-impregnated charcoal filters is being considered to serve as a "polishing filter" for the mercury condenser (refer to Event 17).

[f] Cryogenic charcoal absorbers are being considered as an alternative to the offgas compressor, decay storage tanks, and ambient temperature charcoal filters (refer to Events 24, 30, 31, and 32).

[g] Accidents involving tanker trucks may not be applicable for an proposed SNS facility at this site. It has not been determined how LLLW and process waste would be treated and disposed.

[h] Process waste accidental airborne releases occur at ground level. Only atmospheric dispersion factors for elevated releases were calculated for this site. Based on the radionuclide contents of LLLW and process waste source terms and results for BNL, doses for process waste accidents at this site are anticipated to be approximately 0.001 mrem or less for individuals and to be less than approximately 0.050 person-rem for the off-site population.

NA - Not available.

result in the highest individual and population doses of potential accidents involving the waste handling systems. The dose to the maximally exposed member of the public for these two accidents is 10 mrem and 2.4 mrem for the maximally exposed uninvolved worker. The dose to the maximally exposed member of the public is approximately 3 percent of the 300 mrem received annually by the average person from natural background. The uninvolved worker dose is 3 percent of the average dose received by workers from normal operations at BNL (DOE 1996f). The population dose of 770 person-rem corresponds to 0.4 excess LCFs.

At a power level of 4 MW, the potential consequences of all accidents, except ID 16, would increase by a factor of 4 but would still represent quantified dose of less than 10 mrem to maximally exposed individuals. For the "beyond extremely unlikely" mercury spill (ID 16b), dose to the maximally exposed member of the public would be 2,200 mrem and 920 mrem to the maximally exposed uninvolved worker. The dose to the maximally exposed member of the public is slightly more than 7 times the annual dose from natural background radiation and corresponds to an individual excess risk of LCF of about 1 in 910 chances (0.0011 LCFs).

The dose to the maximally exposed individuals from the off-gas decay system accidents (IDs 24 and 31) would be 41 mrem for the public individual, about 15 percent of the 300-mrem annual dose for natural background, and 9.6 mrem for the uninvolved worker.

Because of the large off-site population and the conservative assumptions underlying the use of dose-to-risk factors, the quantified adverse effects are large for four accidents should they occur at a power level of 4 MW. The accident with the greatest potential consequences is the beyond-design-basis mercury spill (ID 16b). The population dose of 170,000 person-rem corresponds to 85 excess LCFs. The probability that this accident would occur in a given year is less than 1 chance in 1,000,000. Another mercury spill accident (ID 2b) also has quantified adverse health effects in the off-site population. The population dose for this accident of 3,800 person-rem corresponds to 1.9 excess LCFs. The probability that this "extremely unlikely" accident would occur in a given year is between 1 chance in 10,000 and 1 chance in 1,000,000.

The two accidents involving the offgas decay system (ID 24 and ID 31) have the same emission source term and also would have the potential for adverse effects in the off-site population quantified with a magnitude greater than 1.0. The population dose from either accident of 3,100 person-rem corresponds to 1.6 excess LCFs. Accident ID 31 is "extremely unlikely"; Accident ID 24 is "anticipated." Section 5.2.9.3.3 discusses several simple mitigation actions that could be taken that would reduce the frequency of occurrence of Accident ID 24 to "unlikely."

As discussed in Section 5.2.9.2.1, LCF values of 1.0 or greater do not mean that fatalities would actually occur in the off-site population but provide a quantified value for use in comparison between alternatives.

5.5.9.3.4 Hazardous Materials Accidents

Accidents involving potential exposure to toxic materials are discussed in Section 5.2.9.3.4. All involve spills of irradiated mercury. Accident

IDs 2b, 16a, and 16b could result in the OSHA ceiling concentration of 0.1 mg/m^3 being exceeded for a few minutes in locations accessible to workers during the initial stages of these accidents, but it would not be exceeded at or beyond the BNL site boundary. Thus for only a few minutes at the start of the accident, mercury concentrations at or beyond the site boundary might exceed TEEL-1 limit (0.075 mg/m^3) but would not exceed the TEEL-2 limit (0.10 mg/m^3); individuals at the boundary at the precise occurrence of the initial emission might perceive an odor but would not experience or develop irreversible health effects or symptoms that could impair the ability to take protective action.

The secondary and tertiary stages of these accidents are conservatively assumed to last from 7 to 30 days, while in reality, administrative and emergency response actions would more probably terminate the release in a shorter time period. During these stages, airborne concentrations of mercury would remain two to three orders of magnitude below the TEEL-0 limit of 0.05 mg/m^3, and no observable detrimental effects would be expected to occur.

5.5.10 SUPPORT FACILITIES AND INFRASTRUCTURE

This section summarizes the facilities and infrastructure effects on BNL transportation and utility systems from construction and operation of the proposed SNS facility.

5.5.10.1 Transportation

As described in Section 3.2.5, Alternative Sites, construction of the proposed SNS, related infrastructure, and support systems would occur at BNL, located in Suffolk County on Long Island in the state of New York. The wooded and largely undeveloped BNL site is bordered on the south by I-495, on the west by the William Floyd Parkway, on the north by State Highway 25, and on the east by County Route 25. Primary access to BNL is provided via Princeton Avenue from the William Floyd Parkway.

A recent BNL traffic study indicated that the current site population is approximately 3,100 with approximately 2,500 daily round-trips. In 1990, a transportation master plan was completed for BNL. The transportation plan evaluated traffic circulation effects for a future site population of 3,800 employees. At that time, the BNL site population was approximately 3,400 (Vollmer Associates 1990).

Construction vehicles would transport necessary concrete, steel, and related building materials. Construction employee and vehicle activity would increase during the first years of construction, peaking in 2002, and would decrease significantly during the last year (2004) of construction. The estimated total of 578 construction employees in the peak construction year (2002) is expected to add approximately 466 daily round-trips and 10 material/service trucks. This represents a 16 percent increase. This increase is considered to be below a level of significance and, therefore, would not result in significant traffic impacts to the site or surrounding area. However, the nature of the construction vehicles, given their size and speed, would affect traffic composition, and they may affect the flow of vehicles approaching and within BNL during construction. The implementation of mitigation measures, as described in Section 5.10, would minimize such adverse effects.

After construction, operation of the proposed SNS would result in an additional 250 resident/visiting scientists by 2006 and another 125 employees during future facility upgrades. The long-term total of an additional 375 people and 3 service trucks/day (approximately 305 daily round-trips) is not expected to exceed the 1990 Traffic Master Plan's projection of 3,800 employees for the entire BNL facility. Therefore, no significant effects would be expected from operation of the proposed SNS facility at BNL.

Table 5.5.10.1-1 compares the No-Action Alternative with the proposed action at BNL. The table provides the percentage increase in traffic resulting from the proposed SNS facility during construction and operation, as compared to that of the No-Action Alternative. The table also provides the percentage increase using existing site data, as well as projected data for the site. Potential effects of these modest traffic increases could be reduced by having craft and non-craft workers report to work at different times, thus reducing the adverse effects on traffic flow during rush hours. Additionally, this analysis assumed there would be no transferring of personnel from within BNL. If some of the workers were previously working at BNL, the impact on traffic would be reduced.

5.5.10.2 Utilities

This section assesses the potential consequences of the proposed SNS on utilities and utilities infrastructure at BNL.

5.5.10.2.1 Electrical Service

As described in Section 3.2.3.4, the proposed SNS facility would require large supplies of electrical power for operation. In order to accommodate the 4-MW proposed SNS, a new 69-kV transmission line would be required. This line would extend to the Long Island Lighting Company's (LILCO) 138-kV grid, located on the southeast corner of BNL. The length of the line would be approximately 1 mile (1.6 km) and would parallel BNL's existing 69-kV transmission line. The LILCO grid would require a new 138- to 69-kV substation. Required upgrades to the electrical system would occur within existing infrastructure corridors or alignments. Therefore, environmental effects resulting from this upgrade in electrical service at BNL are expected to be minor.

Table 5.5.10.1-1. BNL traffic increases compared to No-Action Alternative.

	Baseline No-Action	(Peak Year) SNS Construction	(4 MW) SNS Operation
Passenger vehicle trips[a]/day	2,500	466	302
Material transport trucks/day	0	7	0
Service trucks/day	0	3	3
Total (% increase)	0 (0%)	476 (16%)	305 (11%)

[a]Based on BNL site population of 3,100.

5.5.10.2.2 Steam

The proposed SNS facility does not necessarily require steam for facility heating; however, steam is available at BNL. The present steam load peaks at 170,000 lb/hr. The existing steam plant has a firm capacity of 295,000 lb/hr. It would be necessary to extend the existing steam pipeline approximately 4,000 ft (1,219 m) to service the proposed SNS facility. The existing steam capacity would be sufficient to meet the 1,500 lb/hr required by the proposed SNS to deal with the Long Island climate. Environmental effects on steam resulting from the proposed SNS facility at BNL would be expected to be inconsequential.

5.5.10.2.3 Natural Gas

Natural gas would provide energy for operational equipment such as boilers and localized unit heaters in the proposed SNS facility's heating system. As described in Section 4.4.10.2.3, natural gas at BNL is distributed from an existing main located near the electrical substation at the southeast corner of the laboratory. Natural gas is distributed to the Central Steam Facility for steam production. Current usage peaks at approximately 200,000 ft^3/hr, and 40,000 ft^3/hr would be available for the proposed SNS. Thus, environmental effects on natural gas distribution to the proposed SNS facility at BNL are expected to be inconsequential.

5.5.10.2.4 Water Service

The proposed SNS facility would require water supplies for the following systems: tower water cooling, deionized cooling, chilled water, building heating, process water, potable water, demineralized water, fire suppression, and target moderators.

The water supply at BNL is obtained from six on-site wells. As described in Section 4.4.10.2.4, the total pumping capacity of the wells is approximately 7,200 gpm (27,255 lpm). Average daily water usage at BNL is approximately 1 mgpd (3.8 million lpd). Given the available supply of water, on-site water treatment, and the water storage capacity at BNL, it is expected that the laboratory can provide the proposed SNS facility with water supplies from existing sources. Environmental effects on water service resulting from the proposed SNS are expected to be minor.

5.5.10.2.5 Sewage Treatment

The STP at BNL was recently renovated, bringing the hydraulic capacity of the plant to 3 mgpd (11.4 million lpd). Its peak use during a recent 10-year storm was 2.2 mgpd (8.3 million lpd). Therefore, sufficient capacity exists to accommodate the additional flow from the proposed SNS facility. Regarding the processing of biodegradable mass, the plant capacity is 250 to 500 lb/day. Approximately 40 lb enters the sewage plant daily. The addition of biodegradable mass from the proposed SNS is expected to improve the efficiency of the existing plant. Therefore, the BNL site would be able to provide sewage treatment for the proposed SNS facility, and environmental effects are expected to be negligible.

5.5.11 WASTE MANAGEMENT

All of the wastes generated during construction and operation of the proposed SNS would be transferred to BNL waste operations for processing. The existing waste management systems for sanitary wastes and liquid low-level radioactive wastes would have sufficient capacity to accommodate wastes from the proposed SNS facility. However, storage capacity for hazardous wastes, liquid low-level and solid LLWs, and mixed wastes would have to be expanded to accommodate SNS wastes. DOE anticipates only minimal effects on the environment from waste management activities associated with the SNS.

Projections of construction and operations waste streams that would be generated at the proposed SNS facility include the following: hazardous waste, LLW, mixed waste, and sanitary/industrial waste, as listed in Table 3.2.3.7. A summarization of existing waste management facilities located at BNL, along with facility design and/or permitted capacities and remaining capacities, can be found in Table 5.5.11-1. Waste stream forecasts for BNL's individual operations, proposed SNS operation at 4 MW, and the aforementioned wastes are also included in Table 5.5.11-1. These forecasts cover the period from 1998 to 2040, unless otherwise noted. They are based on estimates given by waste management facility contacts and waste management documentation.

Before SNS wastes would be accepted for TSD at BNL, they would be certified to meet the WAC of the receiving TSD facility. As mentioned earlier in Section 5.2.11.1, AEA, EPA, and NRC limits for LLLW treatment facility WAC would also need to be addressed for BNL.

Currently, no hazardous waste treatment or disposal facilities are located at BNL. Hazardous wastes are collected, certified, and shipped to DOE-approved licensed commercial treatment or disposal facilities (Petschauer 1998a).

No LLW disposal facilities are located on-site at BNL. These wastes are collected, certified, and shipped to off-site, DOE-approved licensed commercial facilities (Petschauer 1998a).

No mixed waste treatment or disposal facilities are located at BNL. These wastes are collected, certified, and shipped to DOE-approved licensed permitted disposal facilities (Petschauer 1998a).

BNL has a waste certification process in place to ensure that wastes meet the WACs for LLW disposal. However, because of the uncertainty of the composition of LLW and mixed wastes that may be generated from operation of the SNS, the waste may not meet the current WAC for waste management facilities at BNL. DOE would take action to ensure the proper disposition of these wastes. For example, pretreatment of the waste may ensure that they meet the WAC. DOE may be able to amend the license at current waste disposal facilities to allow acceptance of wastes from the SNS.

Sanitary/industrial waste disposal facilities are not present at BNL. These wastes would be sent to a licensed disposal facility off-site (DOE 1997a).

Excess soil, construction wastes, and sanitary wastes would be generated during construction of the proposed SNS. Excavated soil and rock would be used for backfill, erosion control, or other environmental purposes. Construction debris would be sent to a Class IV landfill. Liquid sanitary wastes would be transported to the sanitary wastewater treatment plant at BNL.

Table 5.5.11-1. BNL waste management facility description and capacities.

Waste Disposition	Waste Type and Facility	Total Design Capacity for BNL Site	BNL Waste Projections for 1998-2040	Total Remaining Capacity for BNL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998–2040	Potential Effect of Waste Management on the Environment
HAZARDOUS WASTE						
STORAGE	Liquid/Solid RCRA Hazardous Waste Storage Building	Drum storage bays (30,800 gal); chemical storage rooms (5,000 gal) 650 drums/yr	25 tons/yr (Estimate includes both liquids and solids) 100 drums/yr	No long-term storage	Hazardous Liquid 10,800 gal/yr (200 drums/yr)	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities.
LOW-LEVEL WASTE						
TREATMENT	Liquid Waste Concentration Facility	120,000 gal/yr	50,000 gal/yr	80,000 gal/yr	175,600 gal/yr LLLW 4.15E06 gal/yr process waste potentially LLLW	SNS volume exceeds capacity–waste can be processed at higher rate, if necessary.
	Solid None					
STORAGE	Solid Radioactive Waste Storage Building (Reclamation Building)	270 m³	283 m³/yr	270 m³ – new facility	1,026 m³/yr	Additional storage may be necessary; however, DOE has contracts in place for off-site disposal at DOE-approved licensed commercial facilities.
MIXED WASTE						
STORAGE	Solid/Liquid Mixed Waste Storage Building	22.70 m³	2 m³/yr	20.70 m³ – new facility	Liquid 10.8 m³/yr Solid 7 m³/yr	Minimal effects anticipated. Standard DOE practice has been to dispose of waste at off-site, DOE-approved licensed commercial facilities.

Table 5.5.11-1. BNL waste management facility description and capacities (continued).

Waste Disposition	Waste Type and Facility	Total Design Capacity for BNL Site	BNL Waste Projections for 1998-2040	Total Remaining Capacity for BNL Site (Excludes Proposed SNS Operations)	Proposed SNS Waste Operations Projection for 1998-2040	Potential Effect of Waste Management on the Environment
SANITARY WASTE						
TREATMENT	Liquid Waste Water Treatment Facility	2.3 mgd	800,000 gpd	1.5 mgd	18,750 gpd	No effect anticipated.
	Solid None					
DISPOSAL	Solid Off-site landfills		Trash 842.4 ton/yr Construction Waste 844 ton/yr	NA Off-site landfills	1,349 m^3/yr	No effect anticipated.

Sources: DOE 1997a; Naidu et al. 1996; Petschauer 1998a; Petschauer 1998b.
NA – Not applicable.

Solid sanitary waste would be sent to a sanitary landfill (ORNL 1997b).

As stated in Section 5.2.11, in accordance with the *NSNS Waste Minimization and Pollution Prevention Plan*, considerations for minimizing the production of SNS waste would be implemented.

5.6 NO-ACTION ALTERNATIVE

The No-Action Alternative, as described in Section 3.4, is the alternative under which the proposed SNS facility would not be constructed. This section describes the effects on the existing environment that would result from implementation of this alternative.

5.6.1 GEOLOGY AND SOILS

If the proposed SNS facility is not constructed, there would be no disturbance of geological formations or soils. In addition, there would be no possibility of soil activation. Consequently, the No-Action Alternative would have no effects on geology and soils.

5.6.2 WATER RESOURCES

If the proposed SNS facility is not constructed, there would be no effects on surface water or groundwater resources. Because no soils would be activated, there would be no chance of activation products reaching groundwater. Without operation of the proposed SNS facility, there would be no discharges of cooling water to surface waters. Consequently, implementation of the No-Action Alternative would have no effects on water resources.

5.6.3 AIR QUALITY

No excavation would occur under the No-Action Alternative; thus, there would be no increase in fugitive dust. There would be no deterioration of air quality from construction or operation of the proposed SNS. As a result, implementation of this alternative would have no effects on air quality.

5.6.4 NOISE

No increases in noise levels would occur under the No-Action Alternative because no facility construction or operations would occur. Consequently, its implementation would have no effects on the noise environment.

5.6.5 ECOLOGICAL RESOURCES

This section describes the potential effects implementation of the No-Action Alternative would have on ecological resources. It includes potential effects on terrestrial and aquatic resources, wetlands, and threatened and endangered species.

5.6.5.1 Terrestrial Resources

The proposed SNS facility would not be constructed on any area of land under the No-Action Alternative. As a result, implementation of this alternative would have no effects on terrestrial resources.

5.6.5.2 Wetlands

No area of land would be used for construction of the proposed SNS under the No-Action Alternative. As a result, no wetland areas would be filled, excavated, or otherwise disturbed.

Consequently, implementation of this alternative would have no effects on wetlands.

5.6.5.3 Aquatic Resources

The proposed SNS facility would not be constructed on any area of land under the No-Action Alternative. As a result, this alternative would have no effects on aquatic resources.

5.6.5.4 Threatened and Endangered Species

No area of land would be used for construction of the proposed SNS under the No-Action Alternative. No habitats for endangered or threatened plant or animal species would be affected. Consequently, implementation of this alternative would have no effects on endangered or threatened species.

5.6.6 SOCIOECONOMIC AND DEMOGRAPHIC ENVIRONMENT

This section describes the potential effects on the socioeconomic and demographic environment that would result from implementation of the No-Action Alternative.

5.6.6.1 Demographic Characteristics

Under the No-Action Alternative, there would be no in-migrating construction or operations workers. Therefore, there would be no effects on population growth trends or projections or the race or ethnicity of populations. Consequently, implementation of this alternative would have no effects on the demographic environment.

5.6.6.2 Housing

Under the No-Action Alternative, there would be no in-migrating construction or operations workers who would need housing. Therefore, there would be no effects on numbers of housing units, vacancy rates, housing sales, or apartment vacancy rates. Consequently, implementation of this alternative would have no effects on housing.

5.6.6.3 Infrastructure

Under the No-Action Alternative, there would be no in-migrating construction or operations workers who would need community services. There would be no effects on schools, health care, police protection, or fire protection services. Consequently, implementation of this alternative would have no effects on infrastructure.

5.6.6.4 Local Economy

The proposed SNS facility would not be constructed or operated under the No-Action Alternative. Therefore, no communities would receive additional benefits from increased construction or operations jobs at the proposed SNS. Consequently, the No-Action Alternative would have no effects on local economies.

5.6.6.5 Environmental Justice

Under the No-Action Alternative, there would be no proposed SNS facility, and as such, it would not cause any disproportionately high and adverse human health or environmental effects on minority populations or low-income populations, including Native Americans. Consequently, implementation of the No-Action Alternative would have no effects on environmental justice.

5.6.7 CULTURAL RESOURCES

This section assesses the potential effects on cultural resources that would result from implementation of the No-Action Alternative.

5.6.7.1 Prehistoric Resources

The No-Action Alternative would involve no disturbance of ancient archaeological sites, artifacts, structures, or features at any location. As a result, implementation of this alternative would have no effects on prehistoric cultural resources.

5.6.7.2 Historic Resources

This alternative would involve no disturbance of historic archaeological sites, artifacts, objects, structures, features, or written records. Consequently, implementation of the No-Action Alternative would have no effects on cultural resources dating to the Historic Period.

5.6.7.3 Traditional Cultural Properties

The No-Action Alternative would involve no disturbance of significant places or objects associated with the historical and cultural practices or beliefs of a living community. Consequently, its implementation would have no effects on TCPs.

5.6.8 LAND USE

This section assesses the potential effects on land use that would result from implementation of the No-Action Alternative.

5.6.8.1 Current Land Use

No existing parcel of land would be used for construction of the proposed SNS under the No-Action Alternative. Consequently, implementation of this alternative would have no effects on current land use.

5.6.8.2 Future Land Use

No existing parcel of land would be used for construction of the proposed SNS under the No-Action Alternative. Consequently, implementation of this alternative would have no effects on future land use.

5.6.8.3 Parks, Preserves, and Recreational Resources

No existing parcel of land would be used for construction of the proposed SNS under the No-Action Alternative. Consequently, implementation of this alternative would have no effects on parks, nature preserves, or recreational resources.

5.6.8.4 Visual Resources

No existing parcel of land would be used for construction of the proposed SNS under the No-Action Alternative. Consequently, implementation of this alternative would have no effects on visual resources.

5.6.9 HUMAN HEALTH

This section assesses the potential effects on human health that would result from implementation of the No-Action Alternative.

5.6.9.1 Construction

There would be no risk of adverse effects on the health of SNS workers or the public due to injury or exposure to radioactive or toxic materials since no construction would take place. Consequently, implementation of the No-Action Alternative would have no effects on the health of construction workers or the public.

5.6.9.2 Normal Operations

There would be no risk of adverse effects on the health of workers or the public from exposure to direct radiation or to emissions of radioactive or toxic materials during normal operations of the proposed SNS facility since the SNS would not operate. Consequently, the No-Action Alternative would have no effects on the health of workers or the public.

5.6.9.3 Accident Conditions

There would be no risk of adverse effects on the health of workers or the public from exposure to direct radiation or to emissions of radioactive or toxic materials as the result of accidents during operations of the proposed SNS since the SNS would not operate. Consequently, implementation of the No-Action Alternative would have no effects on the risk of accidents for workers or the public.

5.6.10 SUPPORT FACILITIES AND INFRASTRUCTURE

There would be no additional demands on support facilities and infrastructure because the proposed SNS facility would not be constructed or operated. Consequently, implementation of the No-Action Alternative would have no effects on support facilities or infrastructure.

5.6.11 WASTE MANAGEMENT

No wastes would be generated under the No-Action Alternative. Consequently, this alternative would have no effects on waste management.

5.7 CUMULATIVE IMPACTS OF THE ALTERNATIVES

The Council on Environmental Quality (CEQ) regulations that implement the procedural provisions of the National Environmental Policy Act (NEPA) define cumulative impacts as effects on the environment that result from the addition of the incremental effect of the proposed action to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes the other actions (40 CFR 1508.7). This chapter describes cumulative impacts for geology and soils, water resources, air quality, ecological resources, socioeconomic and demographic characteristics, cultural resources, land use, human health, infrastructure, and waste management facilities.

In the earlier discussions in this chapter, the potential environmental effects of the proposed SNS facility were evaluated with respect to existing conditions or “background.” This takes into account past and present actions on the alternative sites and in the vicinity of the alternative sites. Therefore, discussions in this section will center on the potential effects of reasonably foreseeable future actions in the vicinity of the alternative sites in conjunction with the potential effects from construction and operation of the proposed SNS. The reasonably foreseeable future actions included in the discussions for each alternative site were determined from planning documents and through communications with each site to identify potential actions that may contribute to cumulative impacts on or in the vicinity of the laboratory.

No reasonably foreseeable future actions by nonfederal agencies or persons that might contribute to cumulative impacts were identified.

5.7.1 ORNL ALTERNATIVE (PREFERRED ALTERNATIVE)

The actions that DOE considers reasonably foreseeable and pertinent to the analysis of cumulative impacts for the ORNL Alternative are described in this section. The proposed locations of these actions are shown in Figure 5.7.1-1. These actions are as follows.

Parcel ED-1. DOE completed an environmental assessment (DOE-ORO 1996) for the proposed lease of 957.16 acres of land within the ORR to the East Tennessee Economic Council, a non-profit organization, for a period of 10 years with an option for renewal. The East Tennessee Economic Council proposes to develop an industrial park on the leased site to provide employment opportunities for DOE and contractor employees affected by decreased federal funding. DOE has determined that this action is not a major federal action that would significantly affect the quality of the human environment. However, Parcel ED-1 is included in the discussions of cumulative impacts.

Upgrades to the High Flux Isotope Reactor. DOE is planning several upgrades to the High Flux Isotope Reactor (HFIR) at ORNL. These upgrades include a new Users Facility, a Neutron Science Support Building, and Accelerator and Reactor Improvements and Modifications. Based on the NEPA documentation for these actions (Hall 1989; Hall 1996; and Hall 1997), no environmental effects that would contribute to cumulative impacts with the proposed SNS are anticipated.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Waste Disposal Facility. DOE has published a Remedial Investigation/Feasibility Study for the disposal of ORR CERCLA wastes (DOE-ORO 1998). Alternatives in the Remedial Investigation/Feasibility Study include disposal of CERCLA wastes off-site and in a new disposal facility to be constructed on the ORR. Three alternative sites on the ORR have been considered; two just north of Bear Creek Road and the third along State Highway 95 at the interchange with State Highway 58. The Proposed Plan and Record of Decision (ROD) for the CERCLA Waste Disposal Facility have not been published, so no decisions concerning the construction of this facility on the ORR have been made.

Joint Institute for Neutron Science. This is a facility being funded by the State of Tennessee. It would be constructed near the intersection of Bethel Valley Road and Chestnut Ridge Road on the ORR. Because this would be a state-funded project, Joint Institute for Neutron Science (JINS) would not be a DOE facility. The facility would provide accommodations, including hotel rooms, offices, and meeting rooms, for scientists visiting the neutron science facilities at ORNL. The Division of Facilities Planning, University of Tennessee, is designing the facility. Construction is expected to begin in the summer

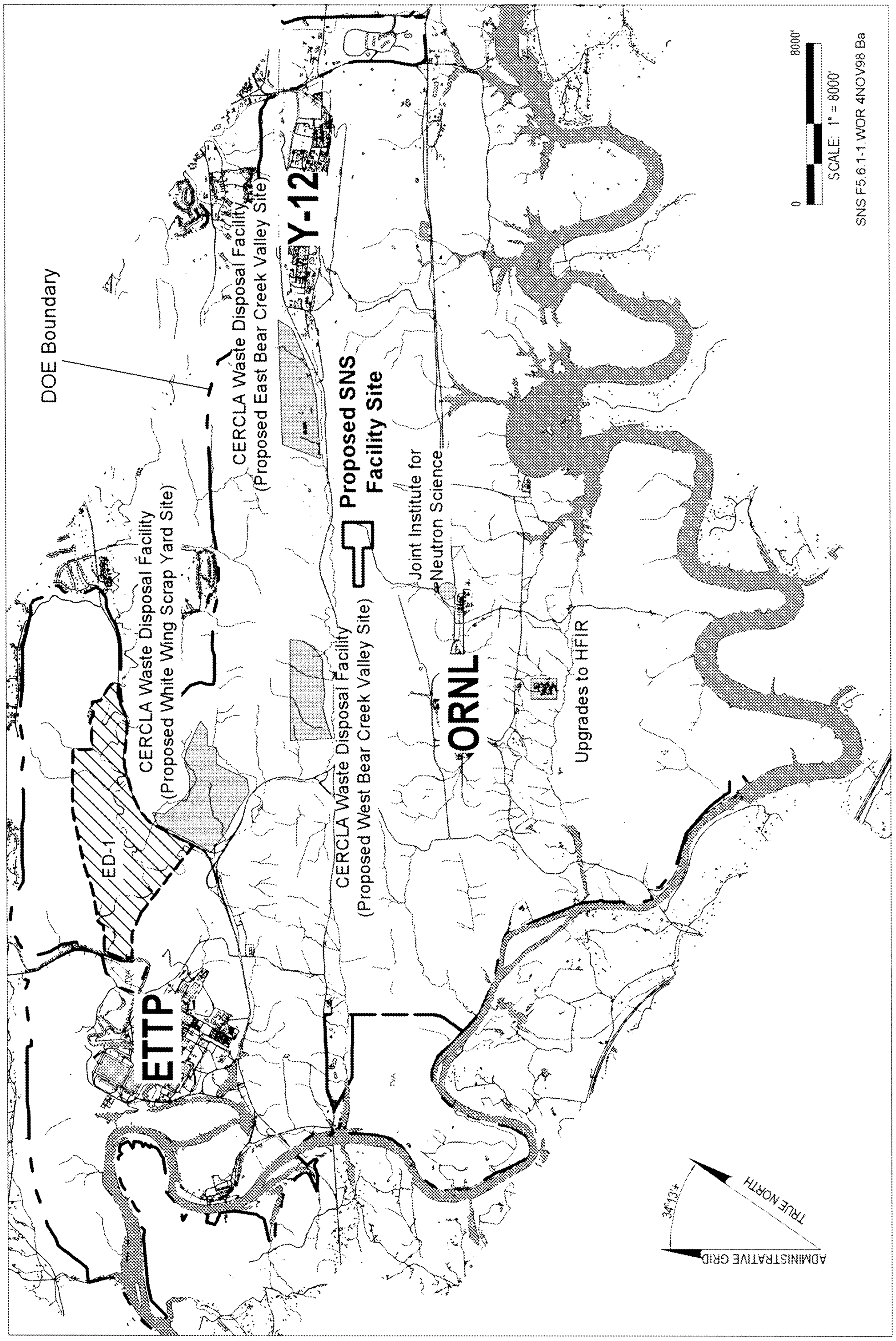

Figure 5.7.1-1. Locations of actions used in the ORNL cumulative impacts analysis.

of 1999, and occupancy would begin in the summer of 2000. NEPA documentation for this facility would be completed in 1999.

Remediation of Contaminated Areas in the Melton Valley Watershed

Contamination in the Melton Valley Watershed originated from operations of ORNL and other facilities over a 50 year period. Numerous active and inactive waste management facilities used by operations at ORNL are located in Melton Valley. ORNL's historic missions of plutonium production and chemical separation during World War II and development of nuclear technology during the postwar era produced a diverse legacy of contaminated inactive facilities, research areas, and waste disposal areas throughout the Melton Valley Watershed that are potential candidates for remediation. A feasibility study has been prepared that documents the development, screening, and detailed evaluation of alternative remedial actions for contaminated areas in the Melton Valley (Jacobs 1997).

5.7.1.1 Geology and Soils

Construction and operation of the proposed SNS facility would not contribute to the cumulative impact on the geology or soils of the ORR or surrounding communities. The proposed SNS would be designed as a stand-alone facility that is physically removed from the main plant area of ORNL. No significant problems have been identified in regard to site stability, seismic risk, the soil medium, or prime or unique farmlands that would constitute impacts by themselves (refer to Section 5.2.1) or combine with existing or future conditions to create cumulative impacts.

5.7.1.2 Water Resources

Construction and operation of the proposed SNS would not contribute to the cumulative impact on the surface water and groundwater of the ORR or surrounding communities. Increased surface water flow due to the discharge from the proposed SNS facility would have temporary effects on the erosion patterns of White Oak Creek and would increase the flow over White Oak Dam by a small amount (refer to Section 5.2.2). However, information to date shows no future activities within ORNL that would add to the current or proposed SNS discharge to further increase flows within White Oak Creek, thereby creating cumulative impacts.

The primary effect of the proposed SNS facility operations on the groundwater of the site would be the activation and leaching of radionuclides (refer to Section 5.2.2.3.2). Since no other radiological source exists in close proximity to the proposed SNS site and radionuclides from the SNS linac tunnel would decay prior to significant transport away from the site, no cumulative impacts would occur. Similarly, no current or planned activities would affect the groundwater supply at the proposed SNS site on Chestnut Ridge.

5.7.1.3 Air Quality

Potential cumulative impacts on air quality are discussed with reference to the air quality in Roane County. Table 5.2.3.2-2 provides collective effects of the ten small boiler stacks at the proposed SNS facility by adding the model-projected maximums for those stacks for each pollutant to an assumed background concentration developed from ambient monitoring maximums measured near the site. These values were then compared to appropriate NAAQS, and no exceedances were noted.

Table 5.7.1.3-1 indicates total hourly emission rates from the ten stacks and compares these values to county-wide average hourly emission rates. The very small percentage increase attributed to the proposed SNS facility is also shown.

No effects from the emission of air pollutants were identified in the NEPA documentation for the development of Parcel ED-1, the CERCLA Waste Disposal Facility, JINS, or the upgrades to HFIR. Similarly, the emissions from the proposed SNS would have a minimal effect on air quality because they would not exceed regulatory standards. The addition of these low SNS emissions to those of the other facilities would be expected to result in a minimal cumulative impact on the air quality of the ORR.

5.7.1.4 Noise

The anticipated future actions would generate additional levels of noise, especially during construction periods. However, these projects would be constructed at different time periods and on different ORR locations. As such, the noise levels would only be additive to existing background noises. Noise effects from the proposed SNS at ORNL are described in Section 5.2.4. It is anticipated that the highest levels would occur during construction and would approach a typical noise level of approximately 86 dBA for such activities. However, the proposed SNS at ORNL would be located in a remote portion of the ORR and would not contribute to other noise sources to increase the overall noise amplitude at the site. Hence, no cumulative impacts are predicted for noise on the ORR.

5.7.1.5 Ecological Resources

This section presents the potential cumulative impacts on ecological resources at ORNL.

5.7.1.5.1 Terrestrial Resources

The ORR has a total of 34,516 acres (13,794 ha) of land. About 80 percent of this land is covered with forest. Approximately 110 acres (45 ha) of forest would be cleared for the proposed SNS. The other planned actions for the ORR would also require the clearing of forests. Parcel ED-1 would require clearing of approximately 500 acres (202 ha) of land (Medley 1998:1). The site for the CERCLA Waste Disposal Facility has not been selected; however, the largest area of land that would have to be cleared is approximately 126 acres (51 ha), if the White

Table 5.7.1.3-1. Comparison of SNS boiler emission rates to county-wide emission totals.

	SNS Emissions (lb/hr)[a]	Roane County Total Average Emission Rate (lb/hr)	% Increase from SNS Emissions
SO_2	0.02	26,947	0.000074
NO_x	3.49	8,634	0.04
CO	0.73	394	0.18
Particulate matter (PM_{10})	0.42	246 (TSP)[b]	0.17

[a] Based on cumulative output of 10 boilers at the proposed SNS with total heat load of 34,870,000 Btu/hr. Boilers do not operate at total heat load continuously.
[b] TSP - total suspended particulates

Wing Scrap Yard site is selected (Jacobs 1998). Construction of the JINS would require clearing approximately 4 acres (1.6 ha). The HFIR upgrades would occur in developed areas; no forests would be cleared. Thus, the total amount of forest to be cleared, including forest on the proposed SNS site, would be 740 acres (300 ha). This would reduce the total acreage of forest on the ORR by approximately 2.5 percent.

This reduction in forested land may reduce the overall population of terrestrial wildlife utilizing the forest habitat. However, this reduction would be minimal, as the reduction in forest habitat is minimal.

5.7.1.5.2 Wetlands

The proposed SNS facility would cause an incremental impact to wetlands on the ORR. Currently proposed projects on the ORR include the CERCLA Waste Disposal Facility, which may result in the destruction of up to 10 acres (4 ha) of wetlands, and the Melton Valley Remediation Project, which could result in up to almost 45 acres (18 ha) of wetland excavation and fill. No impacts on wetlands were identified for construction of the JINS at ORNL or in the environmental assessment for development of Parcel ED-1, a tract leased by DOE to the Community Reuse Organization of East Tennessee for development of an industrial park. Thus, a cumulative total of approximately 56 acres (22 ha) of wetlands may be disturbed or destroyed on the ORR under currently proposed projects. The actual amount of wetland disturbance would depend on the final plans selected for each of these projects. Most of the wetlands that would be affected in the Melton Valley remediation area have contaminated substrates. Thus, excavation and/or fill of these areas would be unavoidable if environmental cleanup is to be completed. However, in all cases, DOE would develop and secure regulator approval of mitigation plans to avoid or minimize impacts and to restore wetland functions through wetland creation, restoration, or enhancement in the same watershed or elsewhere on the ORR. Successful compensatory mitigation would reduce or eliminate the cumulative impacts on the wetland resources of the ORR.

5.7.1.5.3 Aquatic Resources

As stated in Section 5.2.5.3, construction of the proposed SNS on the Chestnut Ridge site would have minimal effects on White Oak Creek. None of the other projects proposed for the foreseeable future would impact White Oak Creek; thus, no cumulative impacts are anticipated.

5.7.1.5.4 Threatened and Endangered Species

As stated in Section 5.2.5.4, the effects of construction of the proposed SNS on the Chestnut Ridge site can be mitigated and would be expected to be minimal. The CERCLA Waste Disposal Facility is also expected to have minimal effects on protected species at any of the three alternative sites (Jacobs 1998). Areas within Parcel ED-1 that may contain protected species or habitat for protected species would be protected during the development of this parcel (DOE-ORO 1996). No effects on protected species have been identified for the HFIR upgrade projects, and enough flexibility exists in siting of the JINS to avoid effects on protected species. Therefore, cumulative impacts on protected species on the ORR would be expected to be minimal.

5.7.1.6 Socioeconomic and Demographic Characteristics

Service sector businesses, government operations (federal, state, and local), retail trade, and manufacturing dominate the economics of the ORNL ROI. Activities included in operation of the ORR are estimated to account for more than 7 percent of the employment, wage and salary, and business activities in the four-county ROI. The effects from upgrades to the HFIR and construction and operation of the JINS would be minimal. The existing on-site workforce would accomplish construction of the upgrades to HFIR, and the current operations staff would operate it. No new jobs would be created, and there would be no effects on housing or community services. JINS is a small facility that would be constructed in less than one year and would be operated by a few people. Construction and operations jobs are expected to be filled by current residents, and there would be no additional effects on housing or community infrastructure.

The goal of the Parcel ED-1 project is to create 1,500 new jobs over the next 10 years. Given the number of persons displaced by DOE downsizing at the ORR facilities in the past five years and the number of unemployed persons in the ROI, it is likely that almost all the direct and indirect jobs created by the development of Parcel ED-1 would be filled by current residents of the ROI. Thus, it is expected that worker in-migration resulting from the proposed action and the effects on housing and community services would be insignificant (DOE-ORO 1996).

The incremental effects from locating the proposed SNS facility on the economy and community infrastructure of the ROI would be minimal. There would be some positive economic benefits in the form of new jobs created by construction and operation of the proposed SNS. Construction of the proposed SNS facility would require 578 full-time employees during the peak year and from 250 to 375 (1 MW to 4 MW) during operations. Most of the construction workforce and about half of the operations workforce would come from the ROI, and as such, the effects on housing and community services would be minimal. The details of these effects are given in Section 5.2.6.

No effects to environmental justice were identified from the upgrades to the HFIR, the construction and operation of the JINS, the construction of a CERCLA Waste Disposal Facility, or the development of Parcel ED-1. The proposed SNS facility would also not have any effects on environmental justice at ORNL. Therefore, there would be no cumulative impacts on environmental justice.

5.7.1.7 Cultural Resources

The cumulative impacts of the proposed action and other actions on the cultural resources of the ORR are assessed in this section.

5.7.1.7.1 Prehistoric Resources

No prehistoric sites listed on or considered to be eligible for listing on the NRHP have been identified on the proposed SNS site at ORNL or in its vicinity. As a result, the proposed action would have no effects on prehistoric cultural resources. Therefore, the proposed action would not contribute to cumulative impacts on the prehistoric cultural resources of the ORR.

5.7.1.7.2 Historic Resources

No Historic Period sites, structures, or features listed on or considered to be eligible for listing on the NRHP have been identified on the proposed SNS site at ORNL or in its vicinity. As a result, the proposed action would have no effect on Historic Period cultural resources. Therefore, the proposed action would not contribute to cumulative impacts on the Historic Period cultural resources of the ORR.

5.7.1.7.3 Traditional Cultural Properties

No TCPs of special sensitivity or concern to the Cherokee are known to exist on the proposed SNS site at ORNL or anywhere else on the ORR. As a result, no TCPs would be affected by implementation of the proposed action. Therefore, the proposed action would not contribute to cumulative impacts on the TCPs of the ORR.

5.7.1.8 Land Use

The cumulative impacts of the proposed action and other actions on ORR land use are assessed in this section.

5.7.1.8.1 Current Land Use

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic characteristics of the land that influence land use in the vicinity of the ORR and on most of the ORR. This would also be true of the effects from industrial development of Parcel ED-1, the CERCLA Waste Disposal Facility, upgrades to HFIR, JINS, and the Melton Valley Remediation Project. Therefore, these would have no reasonably discernible cumulative impacts on current land use outside the ORR or throughout most of the reservation.

The proposed action would introduce large-scale development to approximately 110 acres (45 ha) of proposed SNS site land on the ORR. The Parcel ED-1 industrial park would introduce development to about 500 acres (202 ha) of ORR land (Medley 1998: 1). If the White Wing Scrap Yard is selected for the on-site CERCLA Waste Disposal Facility, 126 acres (51 ha) of undeveloped land would be affected by the project (Jacobs 1998: 7-14 and 8-17). The JINS would introduce development to no more than 4 acres (1.6 ha) of ORR land. The HFIR upgrades would occur in developed and disturbed areas of the 7900 complex at ORNL (Hall 1989: 1; Hall 1996: 1 and 3; Hall 1997: 1 and 4). The Melton Valley Remediation Project would also occur in an area of ORNL that is largely developed and disturbed as a result of waste management activities.

The ORR has approximately 22,490 acres (8,903 ha) of undeveloped land (Medley 1998: 1). Cumulatively, the foregoing facilities would introduce development to about 740 acres (294 ha), which is only 3.3 percent of the undeveloped land on the ORR. Therefore, this cumulative impact on undeveloped ORR land would be minimal.

The proposed action would effectively change the current use of 110 acres (45 ha) of land on the proposed SNS site from Mixed Research/Future Initiatives to Institutional/ Research. The current use of CERCLA Waste Disposal Facility land [White Wing Scrap Yard (high-end scenario)] is Mixed Research/Future Initiatives. If this new waste management facility is built at the scrap yard location, the use of approximately 126 acres (51 ha) of land would change to the Industrial use designation. If JINS is built, approximately 4 acres (1.6 ha) of current Mixed Research/Future Initiatives land would change to Institutional/Research. Current use of the 500 acres (202 ha) slated for development in Parcel ED-1 would have been designated as Mixed Research/Future Initiatives at one time, but, in anticipation of industrial development, its current designation has become Mixed Industrial. No changes in current land use would result from the HFIR upgrades or the Melton Valley Remediation Project.

The current use of approximately 20,000 acres (8097 ha) of ORR land is Mixed Research/Future Initiatives. In addition, approximately 957 acres (387 ha) of land on Parcel ED-1 would have been designated as Mixed Research/Future Initiatives prior to its reclassification in anticipation of industrial development. For the purposes of this cumulative impacts assessment, these figures are summed to obtain a total of 20,957 acres (8,485 ha) of Mixed Research/Future Initiatives land. Cumulatively, the facilities in the foregoing paragraph would change the current use of about 740 acres (300 ha) of Mixed Research/Future Initiatives land. This is only 3.5 percent of the Mixed Research/Future Initiatives land on the ORR. Therefore, this cumulative impact on current land use would be minimal.

National Environmental Research Park

Pollutant emissions from the proposed SNS facility (CO_2 and possibly H_2O vapor) would adversely affect the NOAA TDFCMP and ORNL-ESD ecological research projects in the nearby Walker Branch Watershed (refer to Section 5.2.8.1.1). Construction and operation of the SNS would reduce the current environmental research potential on the approximately 241 acres (98 ha) of land that comprise the Walker Branch Watershed research area (Hanson 1998: 1). Construction of the proposed SNS facility would reduce the current environmental research potential of a minimum 110 acres (45 ha) of NERP land on the proposed SNS site. The CERCLA Waste Disposal Facility [White Wing Scrap Yard (high-end scenario)] would effectively reduce the current environmental research potential of 126 acres (51 ha) of NERP land. The CERCLA documentation for this project indicates that NERP activities, such as research, could be affected by this facility but does not specify any particular environmental monitoring or research projects that would be clearly affected by this facility (Jacobs 1998: 8-32). Industrial construction and operations on Parcel ED-1 would reduce the current environmental research potential of up to 500 acres (202 ha) of NERP land. However, the NEPA documentation for this project does not indicate specific, current environmental monitoring or research projects that would be affected (DOE-ORO 1996: F-3 and 4-1). The HFIR upgrades would have no effect on the current use of ORR land for environmental monitoring or research. JINS would reduce the current environmental research potential of 4 acres (1.6 ha) of NERP land. However, it is not expected to affect current environmental monitoring or research projects on ORR land. The Melton Valley Remediation Project would reduce the current environmental research potential of approximately 69 acres of NERP land in SWSA 6. However, the CERCLA documentation for this project (Jacobs 1997) does not specify any current environmental monitoring or research projects that would be affected.

The ORR NERP contains approximately 21,980 acres (8,899 ha) of land. Cumulatively, the proposed action, CERCLA Waste Disposal Facility, Parcel ED-1, JINS, and the Melton Valley Remediation Project would reduce the current environmental research potential of 1050 acres (425 ha) of NERP land. However, this would be only 4.8 percent of the NERP land on the ORR. Therefore, this cumulative impact on the current research potential of NERP land would be minimal. The cumulative impacts of the foregoing actions on environmental research projects would be uncertain.

5.7.1.8.2 Future Land Use

The proposed action would be compatible with DOE zoning of ORR land on the proposed SNS site. Therefore, it would not contribute to cumulative impacts involving the future use of land for purposes other than those for which it is zoned.

Walker Branch Watershed

Future operation of the proposed SNS facility over a 40-year period would have continuing adverse effects on CO_2 and possibly H_2O vapor monitoring under the TDFCMP in the Walker Branch Watershed unless effective mitigation measures are implemented to minimize these effects. Future ORNL-ESD ecological research projects in this area would also be adversely affected by CO_2 and H_2O vapor emissions from the proposed SNS. However, the NEPA/CERCLA documentation for the CERCLA Waste Disposal Facility, Parcel ED-1, HFIR upgrades, and Melton Valley Remediation Project does not indicate effects from these actions on future environmental research projects. No such effects are anticipated from JINS. Therefore, the cumulative impacts of the foregoing actions on future environmental research projects would be uncertain.

Common Ground Process and End Uses of ORR Land

The proposed action and CERCLA Waste Disposal Facility [White Wing Scrap Yard (high-end scenario)] would be cumulatively at variance with the Common Ground recommendations for future land use on the ORR (refer to Section 4.1.8.3). They are within areas designated for Conservation Area Uses.

The siting of the proposed action on a greenfield site would appear to be at variance with the End Use Working Group recommendation to locate new DOE facilities on brownfield sites. However, as noted in Section 5.2.8.2.2, use of the proposed SNS site would be necessary because no brownfield sites of the required size and configuration could be available by the proposed start date for SNS construction. The other actions considered in this cumulative impacts analysis would not clearly be at variance with the End Use Working Group recommendation. Two of the alternative locations for the CERCLA Waste Disposal Facility would include brownfield sites. However, the White Wing Scrap Yard (high-end scenario) would also contain a large greenfield area. The HFIR upgrades would occur in a developed area of the ORR that could be technically defined as a brownfield. The Melton Valley Remediation Project would result in the installation of various remediation features such as impermeable caps, groundwater diversion trenches, and cryogenic barriers, as opposed to new DOE facilities in the conventional sense. By its very nature, most of the project area is a brownfield. The private sector industrial facilities in Parcel ED-1 would not be DOE facilities. Because JINS would be constructed using State of Tennessee funds, it would not be a DOE facility

5.7.1.8.3 Parks, Preserves, and Recreational Areas Resources

The proposed action would have minimal effects on the following parks, preserves, and recreational resources on and in the vicinity of the ORR: University of Tennessee Arboretum, University of Tennessee Forest Experiment Station, TVA recreation areas on Melton Hill Lake and Watts Bar Lake, and Clark Center Recreation Park. The NEPA/CERCLA documentation for the CERCLA Waste Disposal Facility, Parcel ED-1, and the HFIR upgrades do not identify effects on these specific land uses. JINS would not be expected to affect these uses of the land. The cumulative effect of these actions on parks, preserves, and recreational land use is uncertain, however, it is expected that construction and operation of the SNS would not contribute to cumulative impacts on parks, preserves, or recreational land uses on or in the vicinity of the ORR.

The proposed action would reduce the area of ORR land open to hunting by approximately 110 acres (45 ha). Industrial development of Parcel ED-1 could reduce the area open to recreational hunting by approximately 500 acres (202 ha) (DOE-ORO 1996: 4-18). JINS would reduce the area open to hunting by up to 4 acres (1.6 ha). The NEPA/CERCLA documentation for the CERCLA Waste Disposal Facility and the HFIR upgrades does not identify any effects of these actions on recreational hunting.

Recreational hunting is restricted on approximately 8,000 acres (3,238 ha) of the 34,516 acres (13,968 ha) of land on the ORR (DOE-ORO 1996: 4-18). Thus, approximately 26,516 acres (10,731 ha) are open for hunting. Cumulatively, the proposed action, development of Parcel ED-1, and JINS would reduce the ORR land open to deer hunting by 614 acres (248 ha), or 2.3 percent. Therefore, the cumulative impact of these actions on recreational hunting would be minimal.

5.7.1.8.4 Visual Resources

The SNS, CERCLA Waste Disposal facility (three proposed locations), industrial development on Parcel ED-1, JINS, or HFIR upgrades would not be visible to the public from one vantage point. This would result from a combined function of the distance between facilities, restricted public access to reservation land, topography, and vegetation cover. Therefore, the proposed action would not contribute to cumulative impacts on visual resources.

5.7.1.9 Human Health

None of the reasonably foreseeable actions on the ORR have effluents containing radioactive materials. Therefore, they would not contribute to cumulative impacts with the proposed SNS facility. During normal operations, all SNS effluents containing radioactive or toxic materials would be gaseous. The dose from all ORR airborne emissions in 1996 was 9.9 person-rem to the off-site population and 0.45 mrem to a hypothetical maximally exposed individual. If it is conservatively assumed that the ORR and proposed SNS maximally exposed individuals are in the same location, SNS emissions at 1-MW power would increase these doses to 0.84 mrem for the maximally exposed individual and 26 person-rem for the off-site population. The cumulative dose to the maximally exposed individual would be only 8 percent of the applicable limit. At a power level of 4 MW, these doses would become 2.0 mrem for the maximally exposed individual and 36 person-rem for the off-site population. The cumulative dose to the maximally exposed individual would be 20 percent of the applicable limit. If the same population received these doses for 40 years, 0.52 LCFs could occur from operations on the ORR with a 1-MW SNS facility and 0.72 LCFs could occur for operations on the ORR with a 4-MW SNS facility. LCFs of 1.0 or greater do not mean that any actual deaths would occur. Rather, LCFs provide a common and conservative basis for comparisons of alternatives.

Airborne concentrations of mercury would be approximately 10,000 times less than applicable standards for workers and the public and would not contribute to cumulative toxic health impacts.

5.7.1.10 Infrastructure

This section discusses the cumulative impacts on transportation and utility systems from the upgrades to HFIR, development of Parcel ED-1, and construction and operation of JINS and the proposed SNS facilities on the ORR.

5.7.1.10.1 Transportation

No effects on traffic would result from upgrading the HFIR because the construction upgrades and operation would be performed by the existing workforce. There would be a small increase in traffic during the construction of JINS, but this would only be for less than 1 year. The operation of JINS would add only a few automobiles to the local traffic, and the effects would be minimal.

The development of Parcel ED-1 could eventually generate as many as 7,000 trips per day. The development of this industrial park is intended to provide employment opportunities for DOE and contractor employees affected by decreased federal funding. As such, the vast majority of these employees would be expected to already live in the region and utilize the roads. Therefore, no significant change in levels of service on or nearby roads is expected. The LOS for some roadway segments nearby the proposed SNS site would also be expected to be marginally reduced, especially during construction.

5.7.1.10.2 Utilities

Incremental increases in utilities usage by addition of the reasonably foreseeable future projects would be minimal. Utilities required for the HFIR are not expected to increase noticeably after the upgrades are made. There would be a small incremental increase in the utilities used by JINS but this would be minimal. The development of Parcel ED-1 would occur over a 10-year period. These developments would gradually require more electric power, water, and wastewater treatment, but the DOE water treatment and City of Oak Ridge sewer system are currently operating at about 50 percent capacity. Electrical energy consumption for the whole ORR is about 726,000 MW hr/yr, and availability from the TVA is 13,880,000 MW hr/yr. The proposed SNS facility would require substantial electric power (62 MW for the 1-MW beam and 90 MW for the 4-MW beam), but there is sufficient excess capacity to accommodate the demand. Capacities for other utilities needed to support the proposed SNS are well above the required demands. Details on the impacts to utilities are given in Section 5.2.10.2.

5.7.1.11 Waste Management Facilities

All of the waste generated during construction and operation of the proposed SNS facility would be transferred to ORNL for processing. The existing waste management facilities at ORNL have sufficient capacity to accommodate the known waste streams from the proposed SNS facility (refer to Section 5.2.11). DOE would take the appropriate action necessary to dispose of any waste streams that have unknown composition. The evaluation of potential effects on the waste management systems include projected volumes of waste. These projections include wastes from future activities; thus minimal cumulative impacts on ORNL wastes systems would be anticipated.

Wastes generated by the development of Parcel ED-1 would not enter the ORNL Waste Management system. These wastes would remain the responsibility of the companies utilizing Parcel ED-1. Small volumes of wastes that do not meet the WAC for the CERCLA Waste Disposal facility may enter the ORNL waste system. Small amounts of solid low-level radioactive wastes, hazardous wastes, and mixed wastes would be generated during modifications to HFIR. These wastes have been accounted for in the waste projections used to evaluate the potential cumulative impacts of the SNS wastes.

5.7.2 LANL ALTERNATIVE

DOE recently published the *Draft Site-Wide Environmental Impact Statement for Continued Operations of the Los Alamos National Laboratory* (DOE-AL 1998). This site-wide analysis in large measure is, by its scope, an analysis of cumulative impacts. This document formed the basis for analyzing the cumulative environmental impacts of constructing the proposed SNS at LANL.

The site-wide EIS addresses several proposed alternative actions that are pertinent to the analysis of cumulative impacts. The locations of these actions are shown in Figure 5.7.2-1. These actions are as follows.

Expansion of Low-Level Waste Disposal Capacity. The existing disposal capacity for low-level radioactive waste at LANL is projected to be filled by 2000. Five alternatives for expanding this disposal capacity are described in the LANL site-wide EIS. In the EIS, they are included under the Expanded Operations Alternative for continued LANL operations. They are as follows: (1) develop Zone 4 at TA-54, (2) develop Zone 6 at TA-54, (3) develop both Zones 4 and 6 at TA-54 in stepwise fashion (preferred alternative), (4) develop the north site at TA-54, and (5) develop an undisturbed site at another LANL TA (TA-67) [DOE-AL 1998: Vol. II, 1-8]. The proposed locations for implementation of these alternatives are shown in Figure 5.7.2-1.

Road Construction to Support Pit Production. The Expanded Operations Alternative for continued LANL operations includes construction of a proposed road between TA-55 (Plutonium Facility) and TA-3 (Chemical and Metallurgy Research Building). This road would support pit production operations at the laboratory. Approximately 7 acres (3 ha) of LANL land would be used for this project (DOE-AL 1998:5-99).

In addition to the site-wide EIS, the EIS for the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility (DOE-AL 1995a) was also

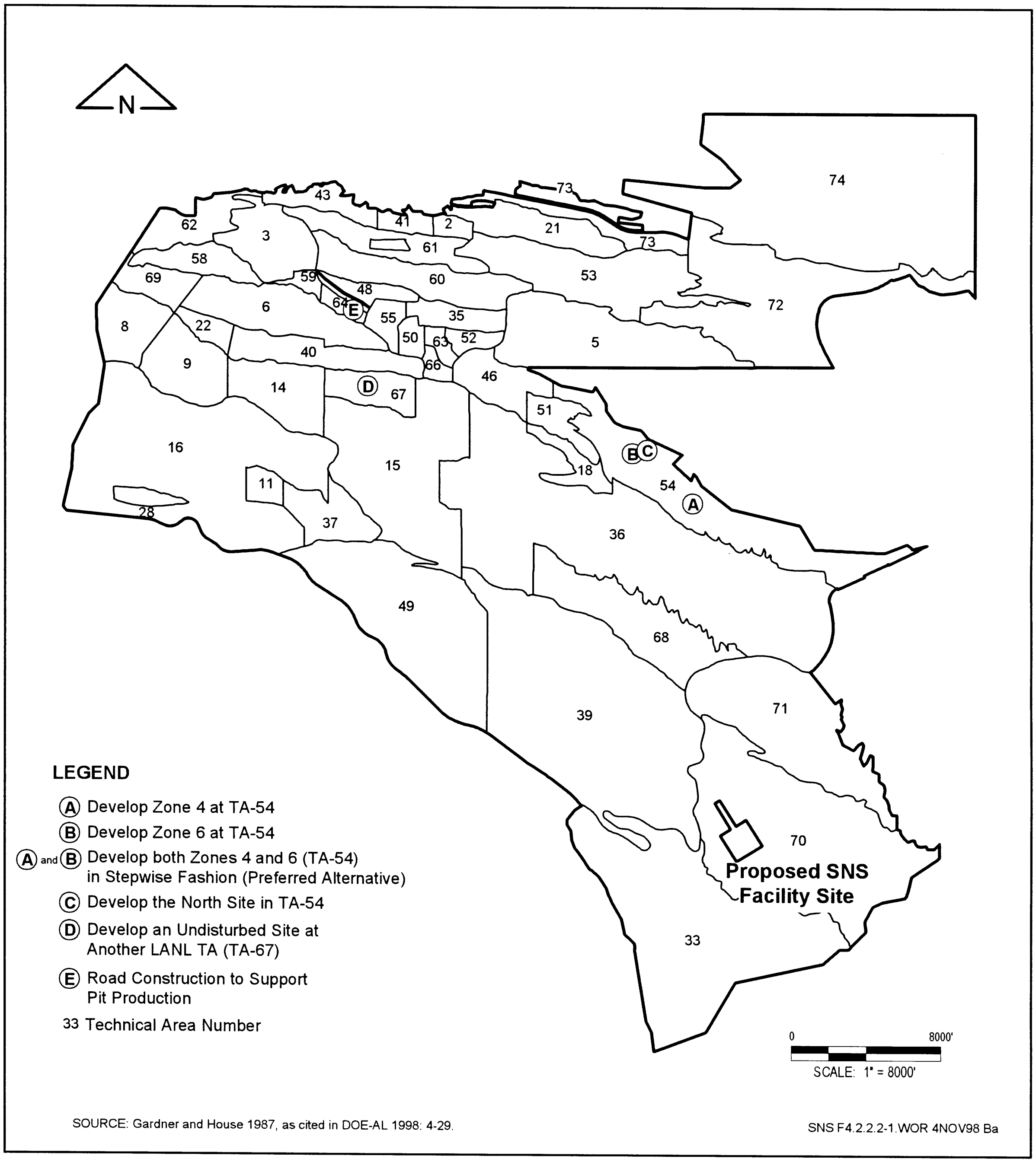

Figure 5.7.2-1. Locations of actions used in the LANL cumulative impacts analysis.

examined. The construction of the DARHT facility is nearing completion. The DARHT facility would provide dual-axis, multiple-exposure radiographs for the study of devices and materials under hydrodynamic conditions. This facility would be used primarily in support of DOE's Stockpile Stewardship and Management Programs. For the most part, the environmental effects discussed in the DARHT EIS are included in the discussion in the LANL site-wide EIS. However, specific information from the DARHT EIS is included in the following discussion when necessary for clarity.

5.7.2.1 Geology and Soils

The proposed SNS facility would not contribute to the cumulative impact on the geology and soils of LANL or surrounding communities. The proposed SNS would be designed as a stand-alone facility at TA-70, which is physically removed from the main area of LANL. No significant problems have been identified in regard to site stability, seismic risk, the soil medium, <u>or prime or unique farmlands</u> that would constitute impacts by themselves (refer to Section 5.3.1) or combine with existing or future conditions to create cumulative impacts.

5.7.2.2 Water Resources

Surface water discharge by the proposed SNS facility would enter a dry arroyo and infiltrate into the arid soils of the site. No other discharges are planned for this area; hence, no cumulative impacts on surface water would occur at the TA-70 site.

LANL and the surrounding local communities are dependent on groundwater for their water supply. The main aquifer in the area is the only groundwater source capable of serving as a municipal water supply. Although not classified as such, it could be considered a sole-source aquifer. An additional 1.2 to 2.3 mgpd (4.5 to 8.7 million lpd) above current demand would be required to support the proposed SNS operations. Water supply studies specific to SNS demand have not been conducted, but it can be reasonably predicted that increased production of 36 to 70 percent from the main aquifer would impact water levels and create competition with private and local users for water resources.

5.7.2.3 Air Quality

Table 5.3.3.2-1 provides collective effects of the ten small boiler stacks at the proposed SNS facility by adding the model-projected maximums for those stacks for each pollutant to an assumed background concentration developed from ambient monitoring maximums measured near the site. These values were then compared to appropriate NAAQS, and no exceedances were noted.

Table 5.7.2.3-1 indicates total hourly emission rates from the ten stacks and compares these values to county-wide average hourly emission rates. The percentage increase to this total from addition of the SNS minimal sources is also shown.

If future facilities were to be located near the proposed SNS, they would have a cumulative impact on air quality in the immediate vicinity of the SNS. The potential cumulative impact of incremental emissions from such facilities would be evaluated and permitted on a case-by-case basis by the state and federal air quality agencies at the appropriate juncture in order to protect public health and welfare.

Table 5.7.2.3-1. Comparison of SNS boiler emission rates to county-wide emission totals.

	SNS Emissions (lb/hr)[a]	Los Alamos County Total Average Emission Rate (lb/hr)	Increase from SNS Emissions (%)
SO_2	0.02	2.1	0.95
NO_x	3.49	84.3	4.1
CO	0.73	22.1	3.3
Particulate matter (PM_{10})	0.42	8.5	4.9

[a] Based on cumulative output of 10 boilers at the proposed SNS facility with total heat load of 34,870,000 Btu/hr. Boilers do not operate at total heat load continuously.

5.7.2.4 Noise

Noise impacts of the proposed SNS facility at LANL are described in Section 5.3.4. It is anticipated that the highest levels would occur during construction and would approach a typical noise level of approximately 86 dBA for such activities. However, the proposed SNS facility would be located in a remote portion of LANL and would not combine with other noise sources to increase the overall amplitude of the laboratory. Hence, no cumulative impacts are predicted for noise at LANL.

5.7.2.5 Ecological Resources

This section presents the potential cumulative impacts to ecological resources at LANL.

5.7.2.5.1 Terrestrial Resources

A total of 12,770 acres (5,108 ha) of piñon-juniper woodland is present at LANL, representing 46.2 percent of the total land area at LANL. The proposed SNS facility would remove approximately 110 acres (45 ha), or less than 1 percent, of piñon-juniper woodland. LANL is relatively large and undeveloped. Therefore, construction and operation of the proposed SNS facility at LANL would have a minimal contribution to cumulative impacts on terrestrial resources.

5.7.2.5.2 Wetlands

No wetlands are located on or near the proposed site for the SNS, and no cumulative impacts on wetlands were identified in the LANL site-wide EIS. Thus, the SNS would not be expected to contribute to cumulative impacts on wetlands at LANL.

5.7.2.5.3 Aquatic Resources

No aquatic resources are located on or near the proposed SNS site in TA-70. Construction and operation of the proposed SNS would not be expected to affect aquatic resources. Thus, the proposed SNS would not contribute to cumulative impacts on these resources at LANL.

5.7.2.5.4 Threatened and Endangered Species

Impacts on protected species are identified in the LANL site-wide EIS. DOE will soon complete the Threatened and Endangered Species Habitat Management Plan. This plan provides long-range planning information for all future projects at LANL, and develops long-range mitigation actions to protect the habitat of protected species at LANL. This plan will be integrated with the LANL Natural Resource Management Plan, providing policies, methods, and recommendations for long-term management of LANL facilities, infrastructure, and natural resources (DOE-AL 1998). Construction and operations activities associated with the proposed SNS facility would be subject to the restrictions and protective measures defined in these plans, thus minimizing any cumulative impacts on threatened and endangered species at LANL.

5.7.2.6 Socioeconomic and Demographic Characteristics

Government operations (federal, state, local, and tribal) and service sector businesses dominate the economics of the LANL ROI. Activities included in the continued operation of LANL are estimated to directly and indirectly account for more than one third of the employment, wage and salary, and business activity in the three county ROI. In addition to continued operations covered under the LANL site-wide EIS, the DARHT facility is estimated to add about 253 new jobs to the economy. About 106 of these new jobs would be directly supported by project construction and operating expenditures. There would be no impacts to housing or community infrastructure (DOE-AL 1995b). The majority of the new jobs would most likely be filled by existing residents.

The incremental effects of the proposed SNS facility on the economy and community infrastructure of the ROI would be minimal. There would be some positive economic benefits in the form of new jobs created by construction and operation of the proposed SNS. Construction of the proposed SNS facility would require 578 full-time employees during the peak year and from 250 to 375 (1 MW to 4 MW) during operations. Most of the construction workforce and about half of the operations workforce would come from the ROI. As such, the effects on housing and community services would be minimal. The details of these effects are given in Section 5.3.6.

No effects on environmental justice would result from continued operation of LANL or the construction or operation of the DARHT or the proposed SNS facilities. Therefore, there would not be any cumulative effects to environmental justice.

5.7.2.7 Cultural Resources

This section assesses the cumulative impacts of the proposed action and other actions on the cultural resources at LANL.

5.7.2.7.1 Prehistoric Resources

The proposed action would result in the destruction of five prehistoric archaeological sites on the 65 percent of the proposed SNS site and adjacent buffer zone that have been surveyed for cultural resources. These sites are eligible for listing on the NRHP. In the unsurveyed area of the proposed SNS site, any prehistoric sites listed on or eligible for listing on the NRHP would also be destroyed. However, the remaining 35 percent of the proposed SNS site and buffer zone have not been surveyed for prehistoric cultural resources. As a result, the potential effects of the proposed action on specific cultural resources in this unsurveyed area cannot be assessed at this time. Therefore, the contribution of such effects to cumulative impacts on prehistoric cultural resources at LANL cannot be accurately assessed. If the proposed SNS site at LANL were selected for construction of the SNS, this area would be surveyed for prehistoric cultural resources. The effects of the proposed action on specific prehistoric cultural resources, including contributions to cumulative impacts, would be assessed prior to the initiation of construction-related activities within this area.

The alternative to construct a new Low-Level Waste Disposal Facility in TA-67 at LANL could potentially destroy 15 prehistoric archaeological sites. All of these sites are eligible for listing on the NRHP. The effects on these cultural resources would be mitigated through archaeological data recovery (DOE-AL 1998: 5-118). The other alternatives for expanding LLW disposal capacity and the road construction to support pit production are not expected to affect prehistoric cultural resources.

Cumulatively, 20 prehistoric cultural resources at LANL would be impacted by the foregoing actions. This is approximately 3 percent of the 770 prehistoric sites at LANL that are eligible for listing on the NRHP. This percentage would probably be much smaller in light of another 322 prehistoric sites that are considered potentially eligible for listing on the NRHP. These low percentages and the mitigation of impacts through archaeological data recovery indicate that the cumulative impacts of the proposed action (65 percent survey area only) and the Area G LLW disposal facility on prehistoric cultural resources at LANL would be minimal.

5.7.2.7.2 Historic Resources

No archaeological sites, structures, or features dating to the Historic Period have been identified within the 65 percent survey area at the proposed SNS site. As a result, the proposed action would have no effect on Historic Period cultural resources within this area. None of the other LANL actions considered in this analysis would affect historic cultural resources. Therefore, implementation of the proposed action within the surveyed area would not contribute to cumulative impacts on Historic Period cultural resources at LANL.

Site preparation activities in the unsurveyed portion of the proposed SNS site would destroy any historic sites, structures, or features listed on or eligible for listing on the NRHP. However, the remaining 35 percent of the proposed SNS site and an adjacent buffer zone have not been surveyed for Historic Period cultural resources. As a result, the potential effects of the proposed action on specific historic resources in this area cannot be assessed at this time. Therefore, the potential contribution of these effects to cumulative impacts on Historic Period cultural resources at LANL cannot be accurately assessed at this time. If the proposed SNS site at LANL were selected for construction of the SNS, this area would be surveyed for specific Historic Period cultural resources. The effects of the proposed action on Historic Period cultural resources, including contributions to cumulative impacts, would be assessed prior to the initiation of construction-related activities within this area.

5.7.2.7.3 Traditional Cultural Properties

Five prehistoric archaeological sites have been identified within the 65 percent survey area on and adjacent to the SNS site at LANL. These TCPs would be destroyed by site preparation activities associated with construction of the SNS. If any prehistoric archaeological sites are located within the unsurveyed 35 percent of the proposed SNS site, these TCPs would also be destroyed by site preparation. However, because the occurrence of such TCPs in this area is unknown, such potential effects cannot be reasonably factored into the analysis of cumulative impacts.

Fifteen prehistoric archaeological sites would be destroyed by expansion of the LLW disposal facility in TA-54. Cumulatively, construction of the SNS and the new LLW disposal facility would affect 20 prehistoric archaeological sites eligible for listing on the NRHP. Although these 20 sites are only 1.5 percent of the 1,295 prehistoric archaeological sites identified at LANL, any losses or damage involving these TCPs would probably be viewed by tribal groups as an adverse cumulative effect.

Some tribal groups have identified the water resources at LANL as TCPs. Sections 5.7.2.2 and 5.7.2.10.2 discuss cumulative effects on water resources at LANL. The cumulative effects identified in these sections would probably be viewed by tribal groups as adverse cumulative effects on water resource TCPs.

The specific identities and locations of other TCPs on and adjacent to the SNS site are not known and cannot be reasonably estimated (refer to Section 4.2.7.3). As a result, the specific effects of the proposed action on such TCPs would be uncertain. The expansion of LLW disposal capacity at LANL and the road construction to support pit production could affect TCPs, but this is uncertain due to a lack of specific information on TCPs at the alternative construction sites and other locations on laboratory land. Therefore, the potential cumulative effects of these proposed actions on TCPs would be uncertain.

5.7.2.8 Land Use

This section assesses the cumulative impacts of the proposed action and other actions on land use at LANL.

5.7.2.8.1 Current Land Use

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic characteristics of the land that influence land use in the vicinity of LANL or across the laboratory as a whole. The same would be true of the alternatives for future expansion of LLW disposal capacity and the proposed road construction to support pit production. Therefore, these actions would have no reasonably discernible cumulative impacts on current land use outside LANL or throughout most of the laboratory.

The proposed action would introduce development to approximately 110 acres (45 ha) of undeveloped land in TA-70. Construction of a new LLW Disposal Facility in TA-67 (worst-case alternative for area of land used) would introduce development to approximately 60 acres (24 ha) of land at LANL (DOE-AL 1998: 5-99). Under the Expanded Operations Alternative for continuing LANL operations, a new road would be constructed to support pit production (DOE-AL 1998: 5-99). This would introduce development to 7 acres (3 ha) of land.

The proposed action and the other foregoing actions would introduce development to about 177 acres (72 ha) of LANL land. This would be only 1.1 percent of the approximately 16,000 acres (6,478 ha) of undeveloped land within the laboratory boundaries. However, only about 2,000 acres (810 ha) out of these 16,000 acres (6,478 ha) of undeveloped land are considered to be suitable for development. The proposed action and other actions would consume about 8.8 percent of the currently undeveloped land that is considered to be suitable for development. However, future building on LANL land that has been previously developed would reduce additional effects on undeveloped land. Therefore, the overall cumulative impacts on undeveloped land at LANL would be minimal.

The proposed action would change the current use of approximately 110 acres (45 ha) of proposed SNS site land from Environmental Research/Buffer to Experimental Science. Construction of the road to support pit production would change 7 acres (3 ha) of Environmental Research/Buffer land to another land use category. The alternatives for expanding LLW disposal capacity would not appear to involve changes in the current use of Environmental Research/Buffer land.

The proposed action and the road construction would reduce the current Environmental Research/Buffer land at LANL by approximately 117 acres (47 ha). Considering the extremely large areas of LANL in current use as Environmental Research/Buffer land (see Figure 4.2.8.2-2), this cumulative impact on current land use would be minimal.

The proposed action, construction of a new LLW Disposal Facility in TA-67, and construction of a new road to support pit production would reduce the environmental research potential of 177 acres of NERP land. This cumulative impact would be minimal because only 0.6 percent of the NERP land at LANL would be affected.

The land on and in the vicinity of the proposed SNS site is not being used for environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on the use of land by such projects.

5.7.2.8.2 Future Land Use

The proposed action would be compatible with DOE zoning for the land on the proposed SNS site at LANL. Therefore, it would not contribute to cumulative impacts involving the future use of land for purposes other than those for which it is zoned.

No future uses of proposed SNS site and vicinity land for environmental research are planned. As a result, the cumulative impacts of the proposed action on specific future research projects cannot be assessed.

5.7.2.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics or other factors that support park, nature preserve, or recreational land uses outside the LANL boundaries. Consequently, implementation of the proposed action on the proposed SNS site would have minimal effects on the use of Santa Fe National Forest and Bandelier National Monument as recreational areas. However, on LANL land, the public use of hiking trails near the proposed SNS site could be potentially restricted or eliminated. The draft EIS covering the continued operation of LANL does not identify potential effects of the considered alternatives on parks, preserves, or recreational land uses. Thus, the cumulative effect of these actions on parks, preserves, and recreational land use is uncertain. However, it is expected that construction and operation of the SNS would not contribute to cumulative impacts on parks, preserves, or recreational land uses on and in the vicinity of LANL.

5.7.2.8.4 Visual Resources

Construction and operation of the proposed SNS facility on the TA-70 site would change views in the area of the site from that of an undeveloped piñon-juniper woodland to industrial development. During the night hours, facility lighting would be visible to travelers on State Route 4 and the access road to the proposed SNS site. No other large, lighted facilities would be present in this remote area of the laboratory. Under the Expanded Operations Alternative for continuing LANL operations, the alternative involving construction of a new LLW Disposal Facility in TA-67 would change views of the Pajarito mesa top in its area from forest to industrial development (DOE-AL 1998: 5-99). Nighttime lighting of this facility would be potentially noticeable to off-site viewers because there are currently no areas along the mesa that are similarly lit (DOE-AL 1998: 5-100). If the proposed action, one of the alternatives for expanding LLW disposal capacity, and the road construction to support pit production were implemented, a slight increase in overall levels of light pollution from LANL could occur. However, from a cumulative impacts perspective, the proposed action and these other actions would have a minimal impact in terms of expanding the overall daytime and nighttime visibility of LANL across the Rio Grande Valley.

5.7.2.9 Human Health

During normal operations, all SNS effluents containing radioactive or toxic materials would be gaseous. Doses from the airborne pathways for the alternatives considered in the LANL site-wide EIS range from lows of 1.88 mrem/yr for the maximally exposed individual and 11 person-rem/yr for the off-site population for the reduced operations alternative to highs of 5.44 mrem/yr for the maximally exposed individual and 33 person-rem/yr for the off-site population for the expanded operations alternative. The annual doses for airborne pathways for the DARHT facility are estimated to be 0.02 mrem for the maximally exposed individual and 0.9 person-rem for the off-site population. The annual doses for the proposed SNS facility would be 0.47 mrem for the maximally exposed individual and 2.0 person-rem for the off-site population for a 1-MW facility and 1.8 mrem for the maximally exposed individual and 5.3 person-rem for the off-site population for a 4-MW facility.

If it is conservatively assumed that (1) the MEI is in the same location for each case; (2) LANL implements the expanded operations alternative as described in the site-wide environmental impact statement (SWEIS); (3) the DARHT is operational; and (4) the SNS operates for 40 years at the 4-MW power level, the maximum cumulative radiological impacts of these activities would be 7.26 mrem/yr for the maximally exposed individual and 39.2 person-rem/yr for the off-site population. Based on a risk conversion factor of 0.0005 LCFs, 0.78 LCFs could occur if all of these facilities operated together for 40 years. LCFs of 1.0 or greater do not mean that any actual deaths would occur. Rather, LCFs provide a common and conservative basis for comparisons of alternatives.

Airborne concentrations of mercury would be approximately 10,000 times less than applicable standards for workers and the public and would not contribute to cumulative toxic health impacts.

5.7.2.10 Infrastructure

This section discusses the cumulative impacts on transportation and utility systems from the continued operation of LANL and construction and operation of the DARHT and proposed SNS facilities.

5.7.2.10.1 Transportation

Continued operation of LANL is not expected to increase the population of Los Alamos significantly, although future land transfers could potentially increase traffic. The construction of the DARHT facility is now nearing completion, and there would not be much of an increase in traffic once the facility is operational. The effects of SNS construction and operation are discussed in Section 5.3.10.1. No other planned activity would result in increased traffic on this road. Thus, minimal cumulative impacts would be expected.

5.7.2.10.2 Utilities

Within the electric power pool that serves LANL, direct use by LANL is about 80 percent of the total. The system serving LANL is near capacity, and projections of future electric power use by LANL under continued operations indicate that demand would exceed capacity. Some solutions are being evaluated, but no specific proposals have been fully developed to remedy this situation. The operation of the DARHT facility would be expected to add another 2,500 MW hr/yr of demand to the existing system. The incremental addition of the proposed SNS facility to the current electric system would be significant. In addition to bringing in a new 115-kV line, strategies for supplying 62 MW to meet the demands for a 1-MW beam and the 90 MW for the 4-MW beam would have to be addressed.

Current and future natural gas capacities would be able to meet the needs for continued operation of LANL, the DARHT, and the proposed SNS facilities. However, there are no existing gas lines or distribution systems in the vicinity of the proposed SNS site, and this infrastructure would have to be installed.

Under the current 3.3 mgpd (12.5 million lpd) demand for potable water from LANL and the surrounding communities, it would be difficult to meet the additional demands of 1.2 to 2.3 mgpd from the proposed SNS facility. Moreover, accommodating the proposed SNS facility would require delivery system upgrades, including many new lines, lift stations, and storage tanks to increase the existing 3.86-mgpd capacity of the system.

Sanitary sewage treatment capacity is more than adequate to meet the current and projected future demands from the continued operation of LANL, DARHT, and the proposed SNS facilities. However, there is no infrastructure in place at the proposed SNS site; the waste would likely have to be trucked to the nearest lift station, which is several miles away, or a treatment and discharge system would have to be installed. The details of the effects on utilities are given in Section 5.3.10.2.

5.7.2.11 Waste Management Facilities

All of the waste generated during construction and operation of the proposed SNS facility would be transferred to LANL for processing. The existing waste management facilities for hazardous wastes, solid low-level radioactive waste, mixed waste, and sanitary waste at LANL have sufficient capacity to accommodate the waste streams from the proposed SNS. The LANL treatment facility for liquid low-level radioactive waste cannot accommodate wastes with tritium. An alternative disposal method would be necessary for these wastes from the proposed SNS facility (refer to Section 5.3.11). The evaluation of potential effects on the waste management systems include projected volumes of waste. These projections include wastes from future activities. Thus, minimal cumulative impacts on LANL waste systems would be anticipated.

5.7.3 ANL ALTERNATIVE

DOE did not identify any reasonably foreseeable future actions at ANL for inclusion in the analysis of cumulative impacts. However, DOE did include the NEPA documentation for the APS in the analysis of cumulative impacts, although this facility has been completed and is operating. The APS (Figure 5.7.3-1) provides high-brilliance X-rays for use by researchers from industry, universities, and national laboratories. The bright X-ray beams are produced by accelerating positrons (particles like electrons, but positively charged) in a circular path to nearly the speed of light. When the beam is bent by magnets, it emits energy in the form of X-rays.

5.7.3.1 Geology and Soils

Construction and operation of the proposed SNS facility would not contribute to the cumulative impact on the geology or soils of ANL or surrounding communities. The proposed SNS facility will be designed as a stand-alone facility in the 800 Area, which is adjacent to the main portion of the proposed SNS site. No significant problems have been identified with regard to site stability, seismic risk, the soil medium, or prime or unique farmlands (refer to Section 5.4.1), and no existing or future conditions would provide cumulative impacts.

5.7.3.2 Water Resources

Construction and operation of the proposed SNS facility would not contribute to the cumulative impact on the surface water and groundwater at ANL or in surrounding communities. A portion of the proposed SNS facility would encroach on portions of the 100-year floodplains associated with two unnamed tributaries of Sawmill Creek and Freund Brook. As indicated in Section 5.4.2.2, construction of the proposed SNS would result in the filling and stabilization of small portions of these floodplains for SNS buildings and related structures. In the affected area along the unnamed tributary of Sawmill Creek, drainage patterns would be altered, and storm drains and canals would be constructed. These storm drains and canals would direct stormwater flow to the retention basin, which would control the discharge of stormwater and cooling water from SNS operations to the unnamed tributary of Sawmill Creek. In the affected area along the unnamed tributary of Freund Brook, construction of the proposed SNS would also require alteration of drainage patterns and construction of storm drains and canals to redirect stormwater flow to Freund

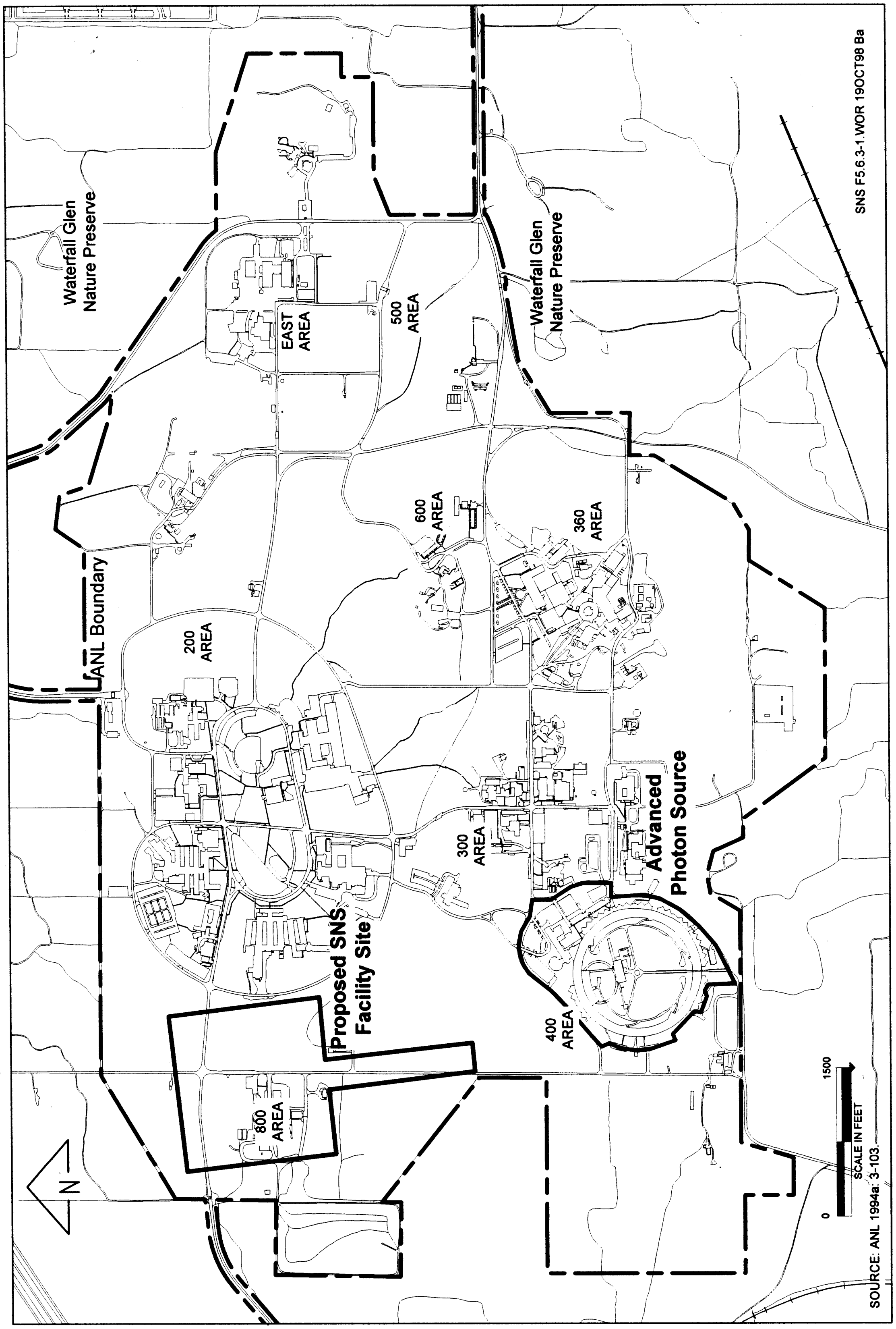

Figure 5.7.3-1. Locations of ANL actions used in the ANL cumulative impacts analysis.

Brook. As a result, construction and operation of the proposed SNS are not expected to have downstream effects on floodplains. The 100-year floodplains would not extend above the proposed SNS site, and no cumulative impacts involving nearby facilities would occur.

The primary effect of SNS operations on groundwater at the site would be the activation and leaching of radionuclides. This impact would be localized to an area immediately adjacent to the proposed SNS facility and limited to the upper soil horizon. Potable aquifers that occur at depths of over 100+ feet in this region would not be impacted. No other radiological sources exist in close proximity to the proposed SNS site, and radionuclides generated at the SNS linac tunnel would decay prior to transport from the site. Therefore, no cumulative impacts would occur. Similarly, no current or planned activities would affect groundwater resources from the potable aquifers since Lake Michigan currently supplies water for ANL.

5.7.3.3 Air Quality

Information on the emission of air pollutants from specific facilities included in this discussion was not available. Therefore, potential cumulative impacts on air quality are discussed with reference to the air quality in DuPage County. Table 5.4.3.2-1 provides collective effects of the ten small boiler stacks at the proposed SNS facility by adding the model-projected maximums for those stacks for each pollutant to an assumed background concentration developed from ambient monitoring maximums measured near the site. These values were then compared to appropriate NAAQS, and no exceedances were noted.

Table 5.7.3.3-1 indicates total hourly emission rates from the ten stacks and compares these values to county-wide average hourly emission rates. The very small percentage increase attributed to the proposed SNS facility is also shown.

If future facilities were to be located near the proposed SNS, they would have a cumulative impact on air quality in the immediate vicinity of the SNS. The potential cumulative impacts from such facilities would be evaluated and permitted on a case-by-case basis by the state and federal air quality regulatory agencies at the appropriate juncture in order to protect public health and welfare.

Table 5.7.3.3-1. Comparison of SNS boiler emission rates to county-wide emission totals.

	SNS Emissions (lb/hr)[a]	DuPage County Total Average Emission Rate (lb/hr)	% Increase from SNS Emissions
SO_2	0.02	100.4	0.02
NO_x	3.49	406.8	0.86
CO	0.73	195.7	0.37
Particulate Matter (PM_{10})	0.42	27.2	1.54

[a] Based on cumulative output of 10 boilers at the proposed SNS facility with total heat load of 34,870,000 Btu/hr. Boilers do not operate at total heat load continuously.

5.7.3.4 Noise

Noise impacts of the proposed SNS facility at ANL are described in Section 5.4.4. It is anticipated that the highest levels would occur during construction and would approach a typical noise level of approximately 86 dBA for such activities. There are no other large construction activities in the vicinity of the proposed SNS site. Thus, no cumulative impacts on noise levels are anticipated. Both the proposed SNS and the APS would be in operation at the same time. Both facilities generate noise from their mechanical draft cooling towers. However, there would be sufficient distance between the two sources of noise to prevent a cumulative impact.

5.7.3.5 Ecological Resources

This section presents the potential cumulative impacts on ecological resources at ANL.

5.7.3.5.1 Terrestrial Resources

The construction of APS required the clearing of 70 acres (28 ha) of land. The total undeveloped land area that would be affected by both the APS and the proposed SNS would be approximately 160 acres (65 ha). This represents approximately 15 percent of the undeveloped land on ANL. This total decrease in undeveloped land would cause a decrease in terrestrial wildlife inhabiting ANL proper. The Waterfall Glen Nature Preserve may provide a refuge for the displaced wildlife. However, applying the argument of Kroodsma (refer to Section 5.4.5.1), the population levels would be permanently reduced by an amount generally proportional to the amount of habitat lost. As stated in Section 5.4.5.1, this would be a minor effect because, except for the fallow deer, the species that would be affected are typical of the surrounding region and are not particularly rare or important as game animals.

5.7.3.5.2 Wetlands

During 1993, a site-wide wetlands delineation was completed for ANL in accordance with the *1987 U.S. Army Corps of Engineers Wetlands Delineation Manual.* This delineation identified 45 acres (18 ha) of natural and man-made wetlands (ANL 1994a). These range from small stormwater ditches that are overgrown with cattails to natural depressions, beaver ponds, and man-made ponds. One of these wetland areas on Freund Brook has partially reverted to upland due to the natural breaching of an old beaver dam.

Construction of the APS resulted in the destruction of 1.8 acres (0.73 ha) of wetlands. The current DOE policy is for no net decrease in the amount of wetlands as a result of DOE activities. Therefore, DOE obtained a permit for construction in wetlands from the USACOE in accordance with Section 404 of the CWA. The lost wetlands were replaced with an equivalent amount of wetland habitat created in the vicinity of the APS facility within the same watershed of the impacted wetlands.

Construction of the proposed SNS facility at ANL would result in the destruction of approximately 3.5 acres (1.4 ha) of wetlands (refer to Section 5.4.5.2). This represents 7.8 percent of the wetland area on ANL land and approximately 0.5 percent of the wetlands in and around ANL. The Waterfall Glen Nature Preserve, which surrounds and is in the same watershed (Des Plaines River) as ANL, contains 601 acres (243 ha) of emergent, swamp, and riverine marsh wetlands. The filling of the wetlands on the proposed SNS site would result in an incremental loss of wetlands in this portion of the Des Plaines River watershed.

DOE would obtain a permit for construction in the wetlands. Creation of replacement wetlands or enhancement of existing wetlands would be the most likely mitigation for this loss of wetland acreage and functions. At a minimum, these replacement wetlands would be designed to replace the structural (vegetation and hydrologic regime) and functional aspects of the wetlands that would be filled. Thus, the unavoidable wetland encroachment on the proposed SNS site is not expected to contribute to cumulative impacts on the wetland resources of the area in and around ANL.

5.7.3.5.3 Aquatic Resources

No permanent streams are located on the site of the APS. Only temporary effects on surface water biota were identified in the Environmental Assessment for the APS. As presented in Section 5.4.5.3, construction of the proposed SNS facility at ANL is expected to cause minimal effects on surface waters. Sawmill Creek currently receives many of the discharges from ANL. However, because of the nature of the aquatic discharges from the proposed SNS, these discharges would be expected to result in minimal contributions to cumulative impacts on Sawmill Creek.

5.7.3.5.4 Threatened and Endangered Species

Construction and operation of the proposed SNS facility would not affect known protected species at ANL. Therefore, there would be no contribution to cumulative impacts on threatened and endangered species at ANL.

5.7.3.6 Socioeconomic and Demographic Characteristics

Service sector businesses constitute one third of the economics of the ANL ROI. Activities included in the operation of ANL account for much less than one percent (0.01) of the employment, wage and salary, and business activity in the four-county ROI. The APS facility created up to 250 jobs during peak construction. As this number decreases, as it has done during the last three years of construction, the APS technical and administrative staff were projected to gradually increase to a stable operations work force of about 300 persons. Some of these new workers could be expected to have in-migrate with their families from outside the ROI, but the effects on housing and community infrastructure would have been minimal.

The incremental effects from the proposed SNS facility on the economy and community infrastructure of the ROI would be minimal. There would be some positive economic benefits in the form of new jobs created by the construction and operation of the proposed SNS. Construction of the proposed SNS facility would require 578 full-time employees during the peak year and from 250 to 375 (1 MW to 4 MW) during operations. Most of the construction workforce and about half of the operations workforce would come from the ROI, and as such, the effects on housing and community services would be minimal. The details of these effects are given in Section 5.4.6.

No effects on environmental justice were identified from the operation of ANL or the construction and operation of the APS. The proposed SNS would also have no effects on environmental justice at ANL. Therefore, there would be no cumulative impacts on environmental justice.

5.7.3.7 Cultural Resources

The cumulative impacts of the proposed action and other actions on cultural resources at ANL are assessed in this section.

5.7.3.7.1 Prehistoric Resources

One prehistoric archaeological site (40DU207), which might be eligible for listing on the NRHP, may be disturbed or destroyed by construction of the proposed SNS facility (refer to Section 5.4.7.1). After the Environmental Assessment for the proposed APS was completed, the remains at 40DU189 (formerly ANL-6) were assessed as ineligible for listing on the NRHP (DOE-CH 1990: 80-81; Wescott 1998b). As a result, the APS would have no impact on prehistoric cultural resources. Therefore, the proposed SNS would not contribute to cumulative impacts on prehistoric cultural resources at ANL.

5.7.3.7.2 Historic Resources

Building 829 is the only Historic Period structure remaining in the 800 Area at ANL. This building is not eligible for listing on the NRHP. As a result, the proposed action would have no effect on Historic Period cultural resources. Therefore, the proposed action would not contribute to cumulative impacts on Historic Period cultural resources at ANL.

5.7.3.7.3 Traditional Cultural Properties

No TCPs are known to exist on the proposed SNS site at ANL or anywhere else on laboratory land. As a result, no TCPs would be affected by implementation of the proposed action. Therefore, the proposed action would not contribute to cumulative impacts on TCPs at ANL.

5.7.3.8 Land Use

The cumulative impacts of the proposed action and other actions on land use at ANL are assessed in this section.

5.7.3.8.1 Current Land Use

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic characteristics of the land that influence land use in the vicinity of ANL and throughout most of the laboratory. This would also be true of the effects from construction and operation of the APS. Therefore, these actions would have no reasonably discernible cumulative impacts on land use outside ANL and throughout most of the laboratory.

The proposed action would introduce development to approximately 90 acres (36 ha) of undeveloped Open Space and Ecology Plot land on the proposed SNS site. Construction of the APS resulted in the development of 70 acres (28 ha) of previously undeveloped land. Cumulatively, these two actions would introduce development to 160 acres (65 ha) of undeveloped ANL land. This would represent an approximately 15 percent reduction in the combined Open Space and Ecology Plot land available for additional development. Considering the already limited space available for development at ANL, this would be a fairly substantial cumulative impact.

Construction of the proposed SNS would displace any remaining support services operations in the 800 Area at ANL, and it would result in demolition of the remaining buildings and features in this area. The current use designations for land on the proposed SNS site (Ecology Plots 6, 7, and 8; Support Services; and Open Space) would change to a programmatic use category specific to the new facility or the Programmatic Mission-Other Areas category. Construction of the APS resulted in a current land use change from Open Space to Programmatic Mission-APS Project. These changes in current land use would involve approximately 75 (30 ha) acres of Open Space land on the proposed SNS site and 70 acres (28 ha) of Open Space land on the APS site. Cumulatively, the proposed action and the APS would reduce the Open Space land at ANL by approximately 145 acres (59 ha). This would represent an approximately 15 percent reduction in the Open Space land available for additional development at ANL. Considering the already limited space available for development, this would be a fairly substantial cumulative impact.

No NERP land is present at ANL. Consequently, the proposed action would not reduce the environmental research potential of NERP land.

The land on and in the vicinity of the proposed SNS site, including Ecology Plot Nos. 6, 7, and 8, is not being used by environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on the use of land by such projects.

5.7.3.8.2 Future Land Use

An extremely small area of land zoned for future use in Support Services is located barely inside the west boundary of the proposed SNS site at ANL. The remainder of the proposed SNS site would be compatible with DOE zoning of this land for future use. The APS site does not contain Support Services zoning and is already dedicated to APS facilities. Therefore, the proposed action would not contribute to cumulative impacts involving the future use of land for purposes other than those for which it is zoned.

No future uses of proposed SNS site and vicinity land for environmental research are planned. This includes Ecology Plot Nos. 6, 7, and 8. As a result, the cumulative impacts of the proposed action on specific future research projects cannot be assessed.

5.7.3.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside the ANL boundaries. Consequently, implementation of the proposed action would have minimal effects on the following land uses on and in the vicinity of ANL: Forest Preserve District of Cook County (recreation on Saganashkee Slough, McGinnis Slough, and small lakes), hunting and fishing in Sawmill Creek and the Des Plaines River, recreational use of an area adjacent to the southwest boundary of ANL, Waterfall Glen Nature Preserve, and ANL Park. The NEPA environmental assessment covering construction and operation of the APS indicates that these actions would have no significant, long-term effects on the Waterfall Glen Nature Preserve (DOE-CH 1990: 65). The environmental assessment does not identify effects on the other previously listed land uses. Thus, the cumulative effect of these actions on these other uses would be uncertain. However, it is expected that construction and operation of the SNS would not contribute to cumulative impacts on these uses.

5.7.3.8.4 Visual Resources

The proposed SNS site is located in close proximity to the west perimeter of ANL, and the currently operating APS site is similarly located near the proposed SNS site and the west perimeter of the laboratory. These facilities would not be visible from points outside the surrounding Waterfall Glen Nature Preserve because the preserve is heavily forested. However, the APS and the proposed SNS would be simultaneously visible from points within ANL. They would also be visible from points near the ANL fence in the Waterfall Glen Nature Preserve, especially on the west side during late autumn, winter, and early spring. Because current views in these areas already contain buildings and other features characteristic of development, the cumulative impacts of the SNS and APS on visual resources would be minimal.

5.7.3.9 Human Health

During normal operations, all SNS effluents containing radioactive or toxic materials would be gaseous. Based on 1996 emissions for all existing ANL facilities, the hypothetical maximally exposed individual received a dose of 0.053 mrem via air pathways, while the off-site population received a dose of 2.64 person-rem. DOE includes the APS in the analysis of cumulative impacts for the proposed SNS facility at ANL. The principal potential health impact from the APS would be exposure to direct radiation. Estimated dose at the ANL site boundary would be 6 mrem/hr due to direct radiation plus an additional 0.06 mrem/yr from the emission of activated air.

Estimates of direct radiation are not available for the proposed SNS, and analysis of cumulative impacts is based on the air pathways. For the proposed 1-MW SNS facility, the air pathway dose to the maximally exposed individual would be 3.1 mrem/yr and 20 person-rem/yr to the off-site population. For the proposed 4-MW SNS facility, the corresponding doses are 12 mrem/yr for the maximally exposed individual and 79 person-rem/yr for the off-site population. The ingestion component of the air pathway dose for the proposed SNS has been conservatively estimated based on the inhalation component of the air pathways. The maximum cumulative dose at the site boundary for the 4-MW facility is 12.1 mrem/yr. Maximally exposed individuals for determining compliance with the 10-mrem/yr limit for exposures based on the air pathway are receptors located only where people actually reside. Maximally exposed individuals in this FEIS are hypothetical receptors located at the site boundary and, at ANL, are much closer to the site than the nearest actual resident. The cumulative affects of SNS emissions at locations where people actually reside would not exceed to limit of 10 mrem/yr. The limit for all pathways including air and direct radiation is 100 mrem/yr.

Based on a risk conversion factor of 0.0005 LCFs/person-rem, the cumulative impacts of ANL emissions with the proposed SNS could result in fatalities at both 1 MW (0.45 LCFs) and 4 MW (1.6 LCFs). LCFs of 1.0 or greater do not mean that any actual deaths would occur. Rather, LCFs provide a common and conservative basis for comparisons of alternatives.

Airborne concentrations of mercury would be approximately 10,000 times less than applicable standards for workers and the public and would not contribute to cumulative toxic health impacts.

5.7.3.10 Infrastructure

This section discusses the cumulative impacts on transportation and utility systems from construction and operation of the APS and proposed SNS facilities at ANL.

5.7.3.10.1 Transportation

ANL is bordered on the north by I-55, on the east by State Highway 83, and on the south by State Highway 171. As of 1994, no marked difficulties were apparent for on-site traffic at any location, either during peak periods of arrival and departure or midday (ANL 1994b). Also, according to Illinois DOT standards, vehicle accumulation at intersections and gates is minimal, even during peak hours. Operating the APS was projected to increase traffic by about 240 trips per day. Locating the proposed SNS at ANL would increase traffic by 466 round-trips during the peak construction year and by 302 round-trips during operations. The addition of the SNS to the existing APS would increase traffic, but the existing transportation infrastructure could accommodate this increase. However, the location within ANL that most closely matches the siting criteria for the SNS overlays Westgate Road. Approximately 1 mile (1.6 km) of the existing Westgate Road would be relocated to the north in order to circumvent the proposed SNS site and replace the existing Westgate Road access. The details of the effects from the proposed SNS are given in Section 5.4.10.1.

5.7.3.10.2 Utilities

Electric power was provided from an existing substation to the APS by two 13-kV feeder circuits that originally serviced the ANL Zero Gradient Synchrotron accelerator facility, which was shut down in 1979 (DOE-CH 1990). ANL's existing 138-kV lines would not be adequate for the SNS loads. A new 138-kV overhead line would be needed to connect the proposed SNS facility to substation 549A to meet the power requirements of the SNS. If additional capacity beyond the available 50 MW is required, it would be necessary to coordinate with Commonwealth Edison to determine the best way to provide power to the site.

The APS was expected to use approximately 60,000 lb/hr of steam. It is expected that the proposed SNS facility would use about the same amount. ANL can accommodate approximately 300,000 lb/hr of additional steam demand.

The potable domestic water supply at ANL is purchased from the local water district. The APS was estimated to use an average of 30,000 gpd (113,562 lpd) of domestic water. The proposed SNS facility would probably use about the same amount, which is four percent of the excess capacity at ANL. Cooling tower water demand for the APS was projected to average 400,000 gpd (1,514,160 lpd) and would come from the Chicago Sanitary and Ship Canal. The proposed SNS is expected to use 800 gpm (3,028 lpm) for the 1-MW beam and 1,600 gpm (6,057 lpm) for the 4-MW beam. ANL has the capacity to provide approximately 2 mgpd (7.6 million lpd), and it is expected that ANL would be able to meet the APS and proposed SNS water requirements with minimal environmental effects. The details of the effects on utilities are given in Section 5.4.10.2.

5.7.3.11 Waste Management Facilities

All of the waste generated during construction and operation of the proposed SNS facility would be transferred to ANL for processing. The existing waste management facilities have sufficient capacity to accommodate the SNS waste streams (refer to Section 5.4.11). The evaluation of potential effects on the waste management systems included projected volumes of waste. Since the APS is an operational facility, wastes from this facility are included in these projections, thus minimal cumulative impacts on ANL wastes systems would be anticipated.

5.7.4 BNL ALTERNATIVE

The actions that DOE considers reasonably foreseeable and pertinent to the analysis of cumulative impacts for the BNL alternative are described in this section. The locations of these actions are shown in Figure 5.7.4-1. These actions are as follows:

Programmed Improvements of the Alternating Gradient Synchrotron (AGS) Complex. DOE prepared an Environmental Assessment for the proposed action to improve the efficiency of the AGS and upgrade the environment, safety, and health systems of the facility. The AGS began operation in 1960 as a proton accelerator supporting research in high-energy physics. The AGS was adapted to accelerate heavy ions in 1986.

Relativistic Heavy Ion Collider. DOE prepared an environmental assessment for the construction and operation of the Relativistic Heavy Ion Collider (RHIC) facility at BNL. The proposed action is to utilize existing facilities at BNL and construct new facilities to complete the RHIC. The RHIC facility would provide a unique, world-class heavy ion research facility.

CERCLA Actions at BNL. In 1980, the BNL site was placed on the New York Department of Environmental Conservation's List of Inactive Hazardous Waste Disposal Sites. In 1989, the laboratory was included on the EPA's National Priorities List of Superfund sites. The inclusion of BNL on both lists was due primarily to the effects of past operations, which posed a potential threat to Long Island's sole source aquifer.

There are 29 Areas of Concern on the BNL site. To ensure effective management, these areas were grouped into five distinct Operable Units. Areas of Concern refer to specific locations of contamination on BNL. The footprint of the proposed SNS at BNL overlies portions of Operable Units III and V.

Operable Unit III was created to address site-specific Areas of Concern, concentrating on groundwater plumes originating from the western portion of BNL. There is a total of 16 Areas of Concern within Operable Unit III; however, none of them are in the vicinity of the SNS footprint (BNL, 1999a).

Operable Unit V is located in the eastern-central portion of BNL. The area includes the Sewage Treatment Plant, an active facility used to process sewage from BNL facilities. There are two Areas of Concern within this Operable Unit. Neither of them is in the vicinity of the SNS footprint (BNL, 1999b).

5.7.4.1 Geology and Soils

The SNS would be designed and constructed as a stand-alone facility. Because of its relative

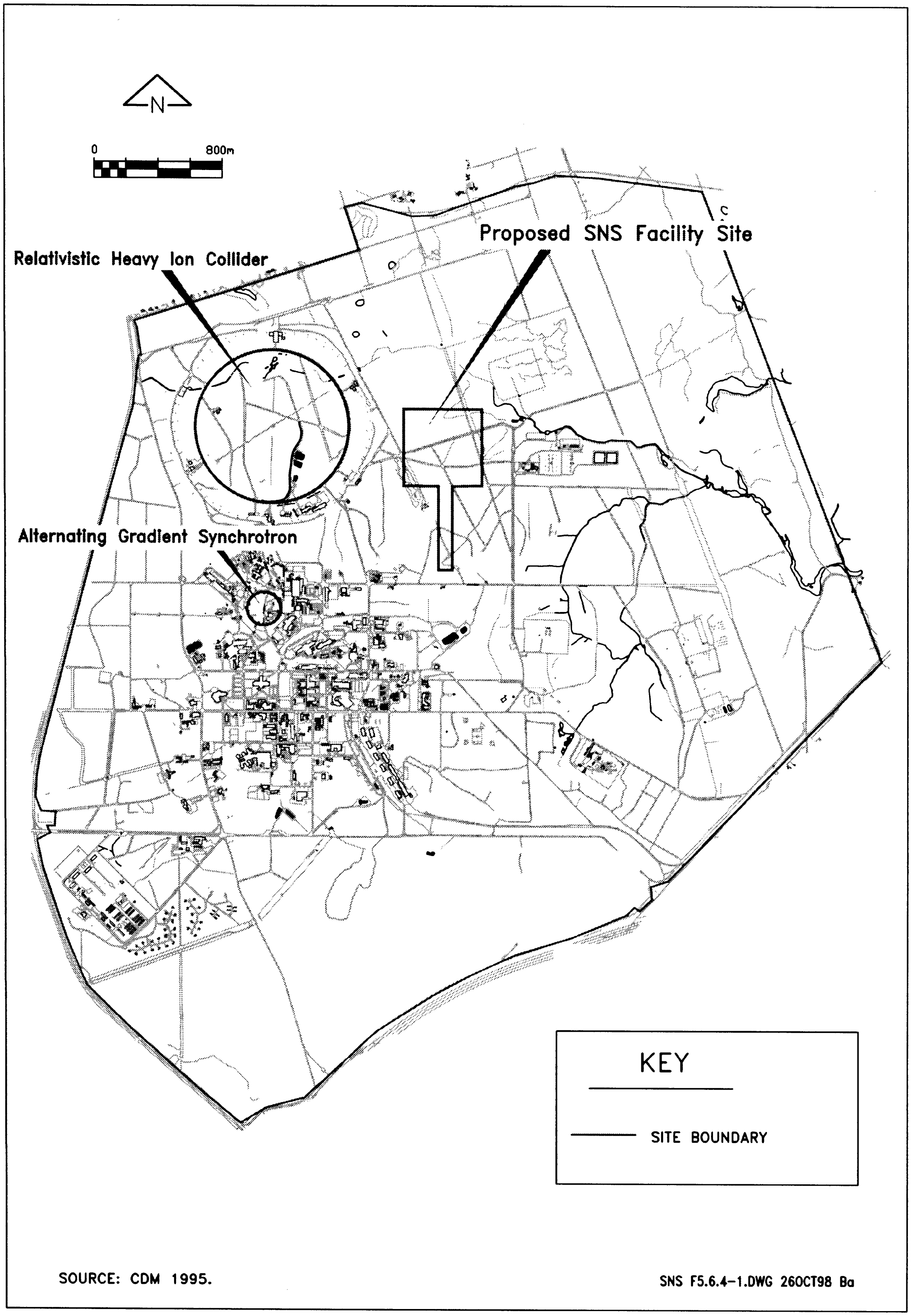

Figure 5.7.4-1. Locations of actions used in the BNL cumulative impacts analysis.

isolation from other BNL facilities, activated soil around the linac tunnel would not combine with other radioactively contaminated soils to create cumulative impacts. No potential conditions have been identified in regard to site stability, seismic risk, or prime or unique farmlands that would constitute impacts by themselves (refer to Section 5.5.1) or combine with existing or future conditions to create cumulative impacts. Therefore, construction and operation of the SNS would not contribute to cumulative impacts on the soils and geology of BNL or the surrounding area.

5.7.4.2 Water Resources

Operation of the proposed SNS facility would create limited amounts of radionuclides in the soils and groundwater surrounding the linac tunnel. Site-specific studies have not been conducted to determine the specific concentrations of radionuclides that would be produced at BNL, but the types of nuclides would be very similar to those predicted for ORNL.

Any SNS contribution of radionuclides would add to those from currently operating and planned radiological sources at BNL. These potential sources include the Brookhaven LINAC Isotope Production Facility, the Alternating Gradient Synchrotron, and the National Synchrotron Light Source. In addition, the HFBR is reported to have released ^{3}H to the groundwater at BNL, and RHIC is predicted to add quantities of several radionuclides, including ^{3}H and ^{22}Na, to the groundwater.

Similar to the SNS, a study (DOE-CH 1991) of the RHIC (currently under construction at BNL) has indicated that secondary particles created by beam interactions would escape into the soil surrounding the tunnel on all sides. From the interaction with the silicon and oxygen atoms in the soil, RHIC is predicted to produce the following radionuclides: ^{3}H, ^{22}Na, ^{7}Be, ^{11}C, ^{13}N, and ^{15}O.

Since the leaching and transport of nuclides is relatively slow, only the longer-lived isotopes such as ^{3}H and ^{22}Na would exist for potential human exposure. An annual total of 11 mCi of ^{3}H and 14 mCi of ^{22}Na are expected to be produced by RHIC. These concentrations would yield a human exposure through the water pathway several orders of magnitude below the Safe Drinking Water Act (SDWA) limit of 4 mrem per year. Assuming a person's intake would consist of 100 percent of water at the BNL boundary, the maximum off-site dose to an individual would be about 0.07 mrem per year.

Due to the proximity of the proposed SNS site and RHIC, the potential exists for commingling of radionuclides from the two facilities. Cumulative impacts, however, would be minimal because of the small amounts generated by each facility, the natural dilution by groundwater, and the isotopic decay over time.

BNL has also identified a groundwater ^{3}H plume derived from the Spent Fuel Pool at the HFBR (BNL 1998). This plume, located in Operable Unit III, has been the focus of a remedial investigation/feasibility study under the CERCLA process, and immediate remedial actions are being taken to remove the ^{3}H sources, mitigate the plume's migration, and characterize the human health exposure at the BNL boundary. The plume trends roughly south from HFBR about 4,200 ft and is approximately 750-ft wide at its greatest dimension. The leading edge of the plume (20,000-pCi/L contour line) would require about 16.4 years to reach the BNL boundary. By that time, natural radioactive decay alone would reduce the ^{3}H concentration to less than half of its current level. Considering the combined effects of groundwater flow, nuclide dispersion, and radioactive decay, groundwater modeling indicates that ^{3}H concentrations above the SDWA level of 20,000 pCi/L would never cross the BNL boundary.

The SNS site is located about 1,500 to 2,000 ft northeast of the HFBR. Due to the configuration of the groundwater gradient within BNL (refer to Figure 4.4.2.2-3), any migration of radionuclides from the SNS site would not intersect the HFBR plume. Hence, cumulative groundwater impacts from the SNS and HFBR would not occur.

The overall picture of cumulative groundwater impacts that might result from operation of the SNS and all the foregoing BNL facilities remains somewhat unclear. However, it is possible that localized groundwater conditions may be affected at BNL, while minimal effects would occur at the laboratory boundary due to the dilution and decay of radionuclides.

It is possible that localized groundwater conditions may be affected at BNL, while minimal effects would occur at the laboratory boundary due to the dilution and decay of radionuclides.

5.7.4.3 Air Quality

Information on the emission of air pollutants from the specific facilities included in this discussion was not available. Therefore, potential cumulative impacts on air quality are discussed with reference to the air quality in Suffolk County. Table 5.5.3.2-1 provides the collective effects of the ten small boiler stacks at the proposed SNS facility by adding the model-projected maximums for those stacks for each pollutant to an assumed background concentration developed from ambient monitoring maximums measured near the site. These values were then compared to appropriate NAAQS, and no exceedances were noted.

Table 5.7.4.3-1 indicates total hourly emission rates from the ten stacks and compares these values to county-wide average hourly emission rates. The very small percentage increase attributed to the proposed SNS facility is also shown.

If future facilities were to be located near the proposed SNS, they would have a cumulative impact on air quality in the immediate vicinity of the SNS. The potential cumulative impacts from such facilities would be evaluated and permitted on a case-by-case basis by the state and federal air quality regulatory agencies at the appropriate juncture in order to protect public health and welfare.

5.7.4.4 Noise

Noise impacts of the proposed SNS facility at BNL are described in Section 5.5.4. It is anticipated that the highest levels would occur during construction and would approach a typical noise level of approximately 86 dBA for such activities. However, the proposed SNS facility would be located west of the main BNL office complex and would be removed from any discernable source of noise produced by that area. No cumulative noise impacts are expected from the two sources.

Table 5.7.4.3-1. Comparison of SNS boiler emission rates to county-wide emission totals.

	SNS Emissions (lb/hr)[a]	Suffolk County Total Average Emission Rate (lb/hr)	% Increase from SNS Emissions
SO_2	0.02	4,350.0	0.00046
NO_x	3.49	2,123.9	0.16
CO	0.73	481.5	0.15
Particulate Matter (PM_{10})	0.42	107.4	0.39

[a] Based on cumulative output of 10 boilers at the proposed SNS facility with total heat load of 34,870,000 Btu/hr. Boilers do not operate at total heat load continuously.

5.7.4.5 Ecological Resources

This section presents the potential cumulative impacts on ecological resources at BNL.

5.7.4.5.1 Terrestrial Resources

As presented in Section 5.5.5.1, the proposed SNS site at BNL lies within the pine barrens area of Long Island. However, the 110 acres (45 ha) of land on the site represents less than 2 percent of the Pine Barrens protection area and lies entirely within the Compatible Growth Area rather than the more stringently protected Core Preservation Area. Cumulative impacts to the Pine Barrens would be minimal. Construction associated with the Programmed Improvements of the AGS complex is limited to areas within existing facilities or existing utility rights-of-way. No land would be cleared.

The Pine Barrens Protection Act was enacted in 1993 after the environmental assessment for RHIC was completed. The land occupied by the RHIC facilities was included in the Compatible Growth Area. The construction of RHIC is utilizing facilities that already existed for the ISABELLE/CBA project at BNL, plus other facilities and components that already were built and operational at BNL. Thus, very little undisturbed land was cleared for RHIC.

5.7.4.5.2 Wetlands

Wetlands occur in the headwaters of the Peconic River. However, construction and operation of the proposed SNS facility would have minimal effects on these wetlands.

Construction-associated improvements to the AGS is limited to areas within existing facilities or existing utility rights-of-way. No land would be cleared.

No construction activities for the RHIC facility occurred in a wetland. However, there was a potential for indirect effects on wetlands. By implementing appropriate mitigation measures, such as immediate mulching and reseeding of disturbed areas and the use of standard erosion control practices adjacent to wetlands, these secondary effects were expected to be minimal. The NYSDEC issued a Notice of Determination of Non-Significance in response to the request for authorization to construct, submitted by DOE to the NYSDEC in accordance with Article 24 of the Environmental Conservation Law, Protection of Freshwater Wetlands. Thus, cumulative impacts on wetlands from the foregoing facilities would be minimal.

5.7.4.5.3 Aquatic Resources

Cumulative impacts on aquatic resources at BNL would be expected to be minimal. The proposed site for the SNS project and the existing RHIC facilities are located within an area designated as “scenic” under the New York State Wild, Scenic, and Recreational River Act. The ISABELLE/CBA facilities, to be used by RHIC, were constructed prior to the 1987 designation of the portion of the Peconic River flowing through BNA as “scenic.” The general public does not have open access for use and enjoyment of the river within the BNL boundary, but the New York State Wild, Scenic, and Recreational River Act applies. At the RHIC location, the Peconic River is an intermittent stream. No impacts on the scenic nature of the river resulting from RHIC activities were identified in the environmental assessment.

The 300-ft (91-m) buffer zone of natural vegetation that would be established between the Peconic River and the proposed SNS would protect the scenic nature of the river.

The only potential effect on the Peconic River identified by the RHIC EA is increased sediment loading during construction. Construction activities at RHIC would be completed prior to the start of construction on the proposed SNS facility. The potential for increased sediment loading in the Peconic River during construction of the proposed SNS also exists. Effective erosion control measures are standard practice at DOE construction sites. This, coupled with the fact that construction activities for these projects would not be concurrent, would result in minimal cumulative impacts on the Peconic River.

5.7.4.5.4 Threatened and Endangered Species

No effects on threatened and endangered species were identified in the EA for the RHIC. Construction and operation of the proposed SNS facility would be expected to result in minimal or no effects on known threatened and endangered species. Thus, the cumulative effects on potential species would be uncertain but would be expected to be minimal.

5.7.4.6 Socioeconomic and Demographic Characteristics

Government operations (federal, state, and local), service sector businesses, and retail trade dominate the economics of the BNL ROI. Activities included in the operation of BNL account for much less than one percent (0.02) of the employment, wage and salary, and business activity in the two-county ROI. The proposed programmed improvements of the AGS would upgrade existing facilities, and the construction and operation would be performed by the current workforce. This proposed action would not create any jobs or cause population changes. Therefore, it would not affect ROI housing demand or community infrastructure. The construction of RHIC would also involve upgrades to existing facilities by the current workforce. However, RHIC would add 200 new jobs during operations. Some of these new workers would in-migrate with their families from outside the ROI, but the effects on housing and community infrastructure would be minimal.

The incremental effects from the proposed SNS facility on the economy and community infrastructure of the ROI would be minimal. There would be some positive economic benefits in the form of new jobs created by construction and operation of the proposed SNS. Construction of the proposed SNS facility would require 578 full-time employees during the peak year and from 250 to 375 (1 MW to 4 MW) during operations. Most of the construction workforce and about half of the operations workforce would come from the ROI, and as such, the effects on housing and community services would be minimal. The details of these effects are given in Section 5.5.6.

No effects on environmental justice were identified from the operation of BNL or the construction and operation of the AGS or RHIC. The proposed SNS facility would also have no effects on environmental justice at BNL. Therefore, there would be no cumulative effects on environmental justice.

5.7.4.7 Cultural Resources

This section assesses the cumulative impacts of the proposed action and other actions on the cultural resources at BNL.

5.7.4.7.1 Prehistoric Resources

No prehistoric sites listed on or considered to be eligible for listing on the NRHP have been identified on the proposed SNS site at BNL or in its vicinity. As a result, the proposed action would have no effect on prehistoric cultural resources. Therefore, the proposed action would not contribute to cumulative impacts on prehistoric cultural resources at BNL.

5.7.4.7.2 Historic Resources

The footprint for the ISABELLE/CBA facility was surveyed and archaeologically tested for cultural resources to support the NEPA process in 1977. These efforts resulted in the location of 14 Historic Period archaeological sites dating to World War I. Subsequently, the New York State Historic Preservation Officer (SHPO) indicated that construction of ISABELLE/CBA could proceed as a result of compliance with requirements under the National Historic Preservation Act (NHPA) and Executive Order 11593 (DOE-CH 1991: 14). After extensive construction had already occurred, the project was cancelled. The RHIC was later proposed for construction entirely within the footprint of the partially constructed ISABELLE/CBA facility. In an opinion issued on January 2, 1991, the SHPO indicated that RHIC would have no effect on cultural resources listed on or eligible for listing on the NRHP (Miltenberger et al. 1990; DOE-CH 1991: 14). This would include Historic Period cultural resources at BNL.

With respect to the other project included in this cumulative impacts analysis, the absence of Historic Period cultural resources in the AGS complex indicates that proposed improvements to the AGS would not affect Historic Period cultural resources at BNL (DOE-CH 1994: 14). Considering the absence of cultural resources impacts from RHIC and AGS, the destruction of potentially NRHP-eligible World War I features at Stations 2, 4, 8, and 10 on the proposed SNS site would not contribute to cumulative impacts on Historic Period cultural resources at BNL.

5.7.4.7.3 Traditional Cultural Properties

No TCPs are known to exist on the proposed SNS site at BNL or anywhere else on laboratory land. As a result, no TCPs would be affected by implementation of the proposed action. Therefore, the proposed action would not contribute to cumulative impacts on TCPs at BNL.

5.7.4.8 Land Use

This section assesses the cumulative impacts of the proposed action and other actions on land use at BNL.

5.7.4.8.1 Current Land Use

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the basic characteristics of the land that influence land use in the vicinity of BNL and throughout most of the laboratory. This would also be true of the effects from RHIC and improvements to the AGS. Therefore, these actions would have no reasonably discernible cumulative impacts on land use outside BNL and throughout most of the laboratory.

The proposed action would introduce development to approximately 110 acres (45 ha) of land on the proposed SNS site. Because of its location on the site of a previous construction project, RHIC would involve very little disturbance of previously undeveloped land (DOE-CH 1991: 27). The AGS improvements would occur within a previously developed area of the laboratory. Therefore, the proposed action would not contribute to cumulative impacts on undeveloped land at BNL.

The proposed action would change the current use of 110 acres (45 ha) of land on the proposed SNS site from Open Space to Industrial/Commercial. The construction of RHIC would occur in the previously developed area associated with ISABELLE/CBA, and the AGS improvements would occur within another Industrial/Commercial land use area. As a result, no changes in current land use would be associated with RHIC and improvements to the AGS. Therefore, the proposed action would not contribute to cumulative impacts on current land use at BNL.

No NERP land is present at BNL. Consequently, the proposed action would not reduce the environmental research potential of NERP land.

The land on and in the vicinity of the proposed SNS site is not being used by environmental research projects. As a result, the proposed action would not contribute to cumulative impacts on the use of land by such projects.

5.7.4.8.2 Future Land Use

The RHIC and AGS improvements would be compatible with the Industrial/Commercial zoning of their sites. Therefore, the proposed action would not contribute to cumulative impacts involving the future use of land for purposes other than those for which it is zoned.

No future uses of proposed SNS site and vicinity land for environmental research are planned. As a result, the cumulative impacts of the proposed action on specific future research projects cannot be assessed.

5.7.4.8.3 Parks, Preserves, and Recreational Resources

The effects of the proposed action would not be of sufficient scope, magnitude, or duration to alter the key land characteristics that support park, nature preserve, and recreational land uses outside the ANL boundaries. Consequently, implementation of the proposed action would have minimal effects on the following land uses in the vicinity of BNL: Brookhaven State Park, Rocky Point State Park, Wildwood State Park, recreational use of the Peconic and Carmens Rivers, Calverton Naval Weapons Plant (recreational areas), Cathedral Pines County Park, South Haven County Park, Wertheim National Wildlife Refuge, and Randall Road Hunting Station. The NEPA documentation for RHIC and the AGS improvements does not identify potential effects on these land uses (DOE-CH 1991; 1994). Thus, the cumulative effect of these actions on parks, preserves, and recreational land use would be uncertain. However, it is expected that construction and operation of the SNS would not contribute to cumulative impacts on parks, preserves, and recreational land uses in the vicinity of BNL.

5.7.4.8.4 Visual Resources

Most of the visual panoramas in the area immediately surrounding BNL and within the laboratory contain features indicative of development. Cumulatively, the proposed action, RHIC, and AGS improvements would be compatible with the existing visual environment of the area. Therefore, the cumulative impact of these actions on visual resources at BNL would be minimal.

5.7.4.9 Human Health

During normal operations, all SNS effluents containing radioactive or toxic materials would be gaseous. Based on 1995 emissions for all existing BNL facilities, the hypothetical maximally exposed individual received a dose of 0.06 mrem via air pathways, while the off-site population received a dose of 3.2 person-rem. DOE includes the RHIC and the programmed improvements of the AGS in the analysis of cumulative impacts for a proposed SNS facility at BNL. Operation of the RHIC and other facilities supporting it would result in an additional dose from air pathways of 0.016 mrem/yr to the hypothetical maximally exposed individual and 6 mrem/yr to the off-site population. Operation of the improved AGS and other facilities in tandem with these improvements would add 0.29 mrem/yr to the maximally exposed individual. No estimate of the increment in dose to the off-site population is available.

For the proposed 1-MW SNS facility, the increment in air pathway dose to the maximally exposed individual would be 0.89 mrem/yr and 20 person-rem/yr to the off-site population. For the proposed 4-MW SNS facility, the corresponding doses are 3.4 mrem/yr for the maximally exposed individual and 76 person-rem/yr for the off-site population. The ingestion component of the air pathway dose for the proposed SNS has been conservatively estimated based on the inhalation component of the air pathways. In spite of this conservatism and the conservatism of assuming that the maximally exposed individual is at the same location in each case, the cumulative dose via air pathways of 3.8 mrem/yr based on the proposed 4-MW SNS facility is still below the applicable limit of 10 mrem/yr.

Based on a risk conversion factor of 0.0005 LCFs/person-rem, the cumulative impacts of BNL emissions with those from the proposed SNS facility could result in fatalities at both 1 MW (0.46 LCFs) and 4 MW (1.6 LCFs). LCFs of 1.0 or greater do not mean that any actual deaths would occur. Rather, LCFs provide a common and conservative basis for comparisons of alternatives.

Airborne concentrations of mercury would be approximately 10,000 times less than applicable standards for workers and the public and would not contribute to cumulative toxic health impacts.

5.7.4.10 Infrastructure

This section discusses the cumulative impacts on transportation and utility systems from the construction and operation of the proposed SNS, programmed improvements on the AGS, and RHIC.

5.7.4.10.1 Transportation

BNL is accessed by three major four-lane, divided highways. Currently, about 2,500 vehicles per day enter and exit BNL. In 1990, a transportation master plan was developed for BNL that evaluated traffic circulation impacts. The results of the study indicate that the transportation infrastructure in and around BNL could adequately service predicted traffic of 3,060 round-trips per day. The programmed improvements on the AGS would not increase traffic because the existing workforce would construct the upgrades and operate the facilities. The existing workforce would also construct the upgrades to existing facilities needed for RHIC. The operation of RHIC would increase traffic by about 160 round-trips per day. Locating the proposed SNS facility at BNL would increase traffic by 466 round-trips during the peak construction year and by 302 round-trips during operations. The addition of all these facilities would increase traffic, but the existing transportation infrastructure could accommodate this increase. The details of the effects from the proposed SNS are given in Section 5.5.10.1.

5.7.4.10.2 Utilities

BNL's current electrical demand is 52 MW. RHIC is projected to require 27.7 MW of electrical power with the injector system (AGS, Booster, LINAC, etc.) using another 16.8 MW strictly for accelerating ions that would be injected into RHIC. The proposed SNS facility would require 62 MW for the 1-MW beam and 90 MW for the 4-MW beam. Approximately 84 percent of BNL's energy demands are met by the New York Power Authority. They have 75,000 kW available for industrial use and would seriously consider requests for additional allocation from BNL for RHIC (DOE-CH 1991). The proposed SNS facility would require a new 69-kV transmission line to the LILCO's 138-kV grid located on the southeast corner of the BNL site. Required upgrades to the electrical systems for all of these facilities would occur within existing infrastructure corridors or alignments. Therefore, cumulative environmental impacts would be expected to be minimal.

The AGS used 1.37 mgpd (5.2 million lpd) of water for operations in 1992. However, the AGS is serviced with a closed-loop cooling system, and essentially all of the water pumped for AGS cooling purposes is returned to the aquifer through recharge basins. RHIC's requirements of 144,000 gpd (545,098 lpd) represent about 3 percent of the margin-of-safe-yield volume of 5.2 mgpd (19.7 million lpd) available to BNL. RHIC would require 450 gpm (1,703 lpm) for cooling purposes. This is a small increment of the 4,500 gpm (17,034 lpm) that BNL withdraws and the 2,250 gpm (8,517 lpm) it returns to recharge basins. The proposed SNS facility would require 800 gpm (3,028 lpm) for the 1-MW beam and 1,600 gpm (6,057 lpm) for the 4-MW beam. BNL has the capacity to pump 7,200 gpm (27,255 lpm) and would be able to accommodate all of these facilities. The details of the effects of the proposed SNS facility on utilities are given in Section 5.5.10.2.

5.7.4.11 Waste Management Facilities

All of the waste generated during construction and operation of the proposed SNS facility would be transferred to BNL for processing. The existing BNL waste management facilities for sanitary wastes and for treatment of liquid low-level radioactive wastes have sufficient capacity to accommodate the waste streams from the proposed SNS. However, current storage capacity for hazardous wastes, low-level radioactive wastes, and mixed wastes would not be able to accommodate the projected volumes of SNS wastes (refer to Section 5.5.11). These projections include wastes from future activities. The current storage facilities would have to be expanded to increase RCRA-permitted storage capacity to accommodate the storage of these future wastes. Considering that BNL recently finished construction of a new waste management facility, a requirement to expand this facility in the future would incur additional resources. Consequently, SNS operations would have an effect on waste management operations at BNL.

5.7.5 NO-ACTION ALTERNATIVE

The proposed SNS facility would not be constructed, operated, or closed at any location under the No-Action Alternative. Consequently, implementation of this alternative would not contribute to cumulative impacts.

5.8 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

The impact assessment conducted in this FEIS has identified potential adverse impacts along with mitigation measures that could be implemented to either avoid or minimize these effects. The residual adverse impacts are unavoidable and are discussed below.

5.8.1 ORNL ALTERNATIVE (PREFERRED ALTERNATIVE)

The unavoidable adverse environmental impacts that would result from implementation of the proposed action at ORNL are as follows:

- Neutron activation of soils in the berm used to shield the linac tunnel.

- Site runoff and the SNS cooling water collected in the approximately 2-acre (0.81-ha) retention basin would be discharged to White Oak Creek at a point south of Bethel Valley Road. The discharge rate would be 0.36 to 0.50 mgpd (1.36 to 1.9 million lpd), increasing stream velocity and channel erosion in White Oak Creek. Potential changes in water parameters, such as an increase in temperature, would occur. As a result of the increased water flow out of

White Oak Lake, radionuclide releases at White Oak Dam would potentially increase by minimal amounts.

- Potential localized increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. Exceedance of drinking water limits for a human receptor would be highly unlikely.

- Removal of vegetation, primarily of oak-hickory forest and planted pine stands, from 110 acres (45 ha) of land on the proposed SNS site. Vegetation would also be removed within new utility corridors and rights-of-way. Vegetation would be removed from approximately 20 percent of NERP Natural Area 52.

- A total of 0.23 acres (0.09 ha) of wetland, comprising portions of three separate wetlands, would be destroyed to allow for upgrading of Chestnut Ridge Road, the primary access road to the proposed SNS site. DOE, in consultation with USACOE and the State of Tennessee, would develop a plan to mitigate these effects either by constructing new wetland habitat or by enhancing existing wetland habitats.

- Introduce large-scale development to the undeveloped proposed SNS site, utility corridors, and new rights-of-way.

- Near-term and future adverse effects of emissions from the SNS boiler stacks on CO_2 monitoring under the TDFCMP in the Walker Branch Watershed. The CO_2 output from the proposed SNS would include exhaust emissions from construction equipment and from personal vehicles driven to the site by operations employees beginning in FY 2005. Two ORNL ecological research projects would be adversely affected by these CO_2 emissions. The CO_2 effects could be mitigated, which would result in minimal effects. The effects of NO_x on TDFCMP monitoring would be minimal. After SNS operations begin in late FY 2005, water vapor emitted by the SNS cooling towers may affect TDFCMP monitoring and eight ORNL ecological research projects, including a continuation of some current projects and several planned projects. In all cases, the effects from emissions would be loss of data quality and data comparability over time.

- Approximately 26,516 acres (10,735 ha) of ORR land are open to the public for recreational deer hunting. Construction of the SNS would reduce the total open to the public for recreational deer hunting by 110 acres (45 ha). This restriction would continue during the operational life cycle of the SNS.

- The proposed SNS facilities would come into view along the upper reaches of Chestnut Ridge Road and the southwest access road to the proposed SNS site. During construction these roads would be traveled by DOE and ORNL personnel, construction workers, and service providers. During operations, they would be traveled by DOE personnel, SNS employees, service providers, and visitors to the SNS facilities, including visiting scientists.

- During normal operations, releases of small amounts of radiation from the proposed SNS facility in the form of direct radiation and airborne emissions would be unavoidable. The potential for adverse effects due to these releases is based on the very conservative assumptions used to estimate ingestion dose to the public based on inhalation dose. The highest doses to maximally exposed individuals and populations from airborne emissions would occur during operations at 4 MW. A member of the public could receive a dose of 1.5 mrem/yr, and an uninvolved worker could receive a dose of 0.37 mrem/yr. Based on the assumption that the proposed SNS operates at 1 MW for 10 years and at 4 MW for 30 years, a total of 0.84 LCFs could occur in the off-site population over the entire 40-year life of the facility.

- Construction and operation of the proposed SNS would increase traffic on the roads leading to the proposed SNS site. The resulting increases in traffic congestion and accidents would be unavoidable and could require upgrading the affected roads to accommodate increased traffic and minimize accidents.

5.8.2 LANL ALTERNATIVE

Implementation of the proposed action at LANL would result in the following unavoidable adverse environmental impacts:

- Neutron activation of soils in the berm used to shield the linac tunnel.

- Site runoff and the SNS cooling water collected in the approximate 2-acre (0.81-ha) retention basin would be discharged to intermittent drainages in TA-70. The discharge rate would be 0.36 to 0.50 mgpd (1.36 to 1.9 million lpd), increasing stream velocity and channel erosion in these intermittent streams. Potential changes in water parameters, such as an increase in temperature, would occur when water is present in the streams.

- Potential localized increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. Groundwater effects would be minimal because of the low soil infiltration rate and great depth [820 ft (250 m)] to the main aquifer.

- Sustained groundwater pumping over 40 years to serve the needs of the proposed SNS facility could lower water levels in area wells and reduce the long-term productivity of the main aquifer that serves the LANL area.

- Removal of vegetation, primarily piñon-juniper woodlands and scattered juniper savannas, from 110 acres (45 ha) of land on the proposed SNS site. Vegetation would also be removed within new utility corridors and rights-of-way.

- Five NRHP-eligible prehistoric archaeological sites within the 65 percent survey area on and adjacent to the SNS site would be destroyed by site preparation activities under the proposed action. In the unsurveyed 35 percent of the proposed SNS site, any prehistoric sites listed on or eligible for listing on the NRHP would also be destroyed during site preparation.

- Thirty-five percent of the proposed SNS site has not been surveyed for historic cultural resources. However, site preparation activities in this area would destroy any historic sites, structures, or features listed on or eligible for listing on the NRHP.

- Five TCPs (all prehistoric archaeological sites in the 65 percent survey area on and adjacent to the SNS site) would be destroyed by site preparation activities under the proposed action. If any prehistoric archaeological sites are located within the unsurveyed 35 percent of the proposed SNS site, these TCPs will also be destroyed by site preparation. The unavoidable adverse impacts on water resources listed in this section would also be unavoidable adverse impacts on TCPs.

- Introduction of large-scale development to the undeveloped proposed SNS site, utility corridors, and new rights-of-way.

- Potential restriction or ending of public hiking trail use near the proposed SNS site in TA-70.

- The proposed action would change views in its vicinity from undeveloped piñon-juniper woodlands to industrial development. During construction and operations, the SNS facilities would be visible to travelers along State Route 4 and the access road to the SNS. These facilities would also be visible from points on the proposed SNS site. During the night hours, facility lighting would be highly noticeable to viewers because no other large, lighted facilities are present in this remote area of LANL. However, the SNS facilities would not be visible from White Rock or popular public use areas in Bandelier National Monument.

- Potable water demand for the proposed SNS facility during operations would exceed the groundwater-based distribution system's capacity by 1.75 mgpd (6.62 million lpd).

- During normal operations, releases of small amounts of radiation from the proposed SNS facility in the form of direct radiation and airborne emissions would be unavoidable. The potential for adverse effects due to these releases is based on the very conservative assumptions used to estimate ingestion dose to the public based on inhalation dose. The highest doses to maximally exposed individuals and populations from airborne emissions would occur during operations at 4 MW. A member of the public could receive a dose of 1.2 mrem/yr, and an uninvolved worker could receive a dose of 0.23 mrem/yr. Based on the assumption that the proposed SNS operates at 1 MW for 10 years and at 4 MW for 30 years, a total of 0.15 LCFs could occur in the off-site population over the entire 40-year life of the facility.

- The proposed SNS site is isolated from the other facilities at LANL and would require a considerable investment in new infrastructure to provide the necessary utilities to the SNS. Moreover, the existing electrical power system at LANL does not have adequate electrical capacity to meet significant future demands such as those required by the proposed SNS. New ways of getting more power to the site would have to be pursued, and there are no pending strategies to do that at this time.

5.8.3 ANL ALTERNATIVE

The unavoidable adverse environmental impacts that would result from implementation of the proposed action at ANL are as follows:

- Neutron activation of soils in the berm used to shield the linac tunnel.

- Site runoff and the SNS cooling water collected in the approximate 2-acre (0.81-ha) sediment retention basin would be discharged to an unnamed tributary of Sawmill Creek. The discharge rate would be 0.36 to 0.50 mgpd (1.36 to 1.9 million lpd), increasing stream velocity and channel erosion in the tributary. Potential changes in water parameters, such as an increase in temperature, would occur.

- Potential localized increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. A potable groundwater aquifer lies at a depth of 165 ft (50 m). The downward rate of water movement through the saturated zone of the Wadsworth Till is only 3.0 ft/yr (0.9 m/yr). High clay content of the till would retard radionuclide migration, but accurate prediction of migration rates and the potential for aquifer contamination would be difficult because of the complex deposits.

- Construction in small areas on the 100-year floodplains of two unnamed tributaries of Sawmill Creek and Freund Brook. The areas of floodplain that would be affected are, respectively, approximately 5 acres (2 ha) and <1 acre (0.40 ha).

- A total of 3.5 acres (1.4 ha) of wetland habitat would be destroyed to allow construction of the proposed SNS facility. DOE, in consultation with the USACOE and the State of Illinois, would develop a plan to mitigate this effect, either by constructing new wetland habitat or by enhancing existing wetland habitats.

- Removal of vegetation from Ecology Plots 6, 7, and 8 and Open Space land on the proposed SNS site. Vegetation would also be removed within new utility corridors and rights-of-way.

- Introduction of large-scale development to Ecology Plots 6, 7, and 8, Open Space land on the proposed SNS site, utility corridors, and new rights-of-way.

- The proposed SNS site would be located in proximity to the west perimeter fence of ANL. This fence would be adjacent to the Waterfall Glen Nature Preserve. During construction and operations, the SNS facilities would be visible from points near the ANL fence in the preserve, especially on the west side during late autumn, winter, and early spring.

- During normal operations, releases of small amounts of radiation from the proposed SNS facility in the form of direct radiation and airborne emissions would be unavoidable. The potential for adverse effects due to these releases is based on the very conservative assumptions used to estimate ingestion dose to the public based on inhalation dose. The highest doses to maximally exposed individuals and populations from airborne emissions would occur during operations at 4 MW. A member of the public could receive a dose of 6.8 mrem/yr, and an uninvolved worker could receive a dose of 0.15 mrem/yr. Based on the assumption that the proposed SNS operates at 1 MW for 10 years and at 4 MW for 30 years, a total of 3.1 LCFs could occur in the off-site population over the entire 40-year life of the facility.

- The proposed SNS site is within the 800 Area at ANL, and the footprint for this site would overlay Westgate Road. Approximately 1 mile (1.6 km) of the existing Westgate Road would have to be relocated to replace the existing ANL site access.

5.8.4 BNL ALTERNATIVE

Implementation of the proposed action at BNL would result in the following unavoidable adverse environmental impacts:

- Neutron activation of soils in the berm used to shield the linac tunnel.

- Site runoff and the SNS cooling water collected in the approximate 2-acre (0.81-ha) retention basin would be discharged to the headwaters of the Peconic River. The discharge rate would be 0.36 to 0.50 mgpd (1.36 to 1.9 million lpd), increasing stream velocity and channel erosion in the river. Potential changes in water parameters, such as an increase in temperature, would occur.

- Potential increase in groundwater radionuclide concentrations due to leaching of neutron-activated soil in the shielding berm for the linac tunnel. The sole source aquifer for Long Island would lie only 20 ft (6.1 m) below the proposed SNS site. High permeability of the soils [17 ft/yr (5.2 m/yr)] would allow unacceptably high levels of radionuclides in the aquifer in the immediate vicinity of the proposed SNS site. Exceedance of drinking water limits for a human receptor at an off-site location would be unlikely.

- Removal of vegetation from 110 acres (45 ha) of Open Space land on the proposed SNS site. This vegetation would be primarily oak and pine forest in the Compatible Growth Area of the established Pine Barrens Protection Area. Vegetation would also be removed within new utility corridors and rights-of-way.

- A number of potentially NRHP-eligible earthen features at Stations 2, 4, 8, and 10 on the proposed SNS site may have been associated with World War I trench warfare training at Camp Upton. They would be destroyed by construction activities under the proposed action.

- Introduction of large-scale development to the undeveloped proposed SNS site, utility corridors, and new rights-of-way.

- The proposed action would add the SNS facilities to an existing visual environment indicative of development.

- During normal operations, releases of small amounts of radiation from the proposed SNS facility in the form of direct radiation and airborne emissions would be unavoidable. The potential for adverse effects due to these releases is based on the very conservative assumptions used to estimate ingestion dose to the public based on inhalation dose. The highest doses to maximally exposed individuals and populations from airborne emissions would occur during operations at 4 MW. A member of the public could receive a dose of 2.6 mrem/yr, and an uninvolved worker could receive a dose of 0.13 mrem/yr. Based on the assumption that the proposed SNS operates at 1 MW for 10 years and at 4 MW for 30 years, a total of 2.1 LCFs could occur in the off-site population over the entire 40-year life of the facility.

5.8.5 NO-ACTION ALTERNATIVE

The proposed SNS would not be constructed, operated, or retired at any location under the No-Action Alternative. Consequently, no unavoidable adverse environmental impacts would result from implementation of this alternative.

5.9 SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

The proposed action is projected to last for a minimum period of 40 years on the alternative site selected for construction and operation of the SNS. The effects of this short-term use of the environment and the No-Action Alternative on the long-term productivity of the environment are assessed in this section.

5.9.1 ORNL ALTERNATIVE (PREFERRED ALTERNATIVE)

DOE has no current plans to return the proposed SNS site to environmental conditions approaching those of a greenfield at the end of its operational life cycle, although this option has not been totally eliminated from consideration. If such an option were implemented, the proposed SNS site environment would be available for productive uses commensurate with the cleanup levels achieved during site remediation.

Two possible options for decommissioning of the proposed SNS are being actively considered: in situ decommissioning and limited decontamination combined with in situ decommissioning. As a result, use of the 110-acre (45-ha) SNS site and adjacent land for other productive purposes could be limited for an indeterminate number of years beyond the operational life cycle of the SNS. The proposed SNS site represents less than one half percent of the total forested area on the ORR.

Impacts would occur on the development of groundwater in the immediate vicinity of the SNS site due to the release of radionuclides. The impact on groundwater productivity would be localized and insignificant in terms of unaffected groundwater resources within the surrounding watershed that would be available for development.

5.9.2 LANL ALTERNATIVE

The primary source of potable water for LANL and the Los Alamos area is a groundwater aquifer. This aquifer is not officially designated as a sole source aquifer, but it essentially functions as one. Operation of the proposed SNS would require 1.2 to 2.3 mgpd (4.5 million lpd) of groundwater from this aquifer. If the continuous daily demand for SNS operations were only half of what would actually be required to operate the proposed 4-MW SNS facility, pumping of water from the main aquifer would have to increase by 25 percent to meet this demand. Sustained pumping at this magnitude over much of the minimum 40-year operational life cycle of the proposed SNS facility could lower water levels in nearby wells and ultimately affect the long-term productivity of the main aquifer. Lower water levels would occur if water withdrawal rates from the main aquifer exceed natural recharge in the arid climate of the Los Alamos area. This possibility would place water demands for the proposed SNS facility in competition with future growth demands by commercial, industrial, and residential users. These potential limitations on aquifer productivity could persist for an indeterminate period beyond the operational life cycle of the proposed SNS.

Impacts would occur on the development of groundwater in the immediate vicinity of the SNS site due to the release of radionuclides. The impact on groundwater productivity would be localized and insignificant in terms of unaffected groundwater resources within the surrounding watershed that would be available for development.

DOE has no current plans to return the proposed SNS site to environmental conditions approaching those of a greenfield at the end of its operational life cycle, although this option has not been totally eliminated from consideration. If such an option were implemented, the proposed SNS site environment would be available for productive uses commensurate with the cleanup levels achieved during site remediation.

Two possible options for decommissioning of the proposed SNS are being actively considered: in situ decommissioning and limited decontamination combined with in situ decommissioning. As a result, use of the 110-acre (45-ha) SNS site and adjacent land for other productive purposes could be limited for an indeterminate number of years beyond the operational life cycle of the SNS. The proposed SNS site represents approximately 10 percent of the piñon-juniper habitat in TA-70.

5.9.3 ANL ALTERNATIVE

DOE has no current plans to return the proposed SNS site to environmental conditions approaching those of a greenfield at the end of its operational life cycle, although this option has not been totally eliminated from consideration. If such an option were implemented, the proposed SNS site environment would be available for productive uses commensurate with the cleanup levels achieved during site remediation.

Two possible options for decommissioning of the proposed SNS are being actively considered: in situ decommissioning and limited decontamination combined with in situ decommissioning. As a result, use of the 110-acre (45-ha) SNS site and adjacent land for other productive purposes could be limited for an indeterminate number of years beyond the operational life cycle of the SNS.

Impacts would occur on the development of groundwater in the immediate vicinity of the SNS site due to the release of radionuclides. The impact on groundwater productivity would be localized and insignificant in terms of unaffected groundwater resources within the surrounding watershed that would be available for development.

5.9.4 BNL ALTERNATIVE

Operation of the proposed SNS facility would result in some neutron activation of the soils in the linac berm, even with specially engineered, multilayer shielding. The minimal ability of proposed SNS site soils to retard the transport of contaminants in groundwater and their high permeability would allow for the leaching of contaminated soils and rapid migration of radionuclides to the sole source aquifer that lies only 20 ft (6.1 m) beneath the proposed SNS site. Radionuclide accumulations in this aquifer could reach unacceptable levels, although contaminant migration to off-site locations in concentrations of concern to local drinking water quality would be improbable.

Impacts would occur on the development of groundwater in the immediate vicinity of the SNS site due to the release of radionuclides. The impact on groundwater productivity would be localized and insignificant in terms of unaffected groundwater resources within the surrounding watershed that would be available for development.

DOE has no current plans to return the proposed SNS site to environmental conditions approaching those of a greenfield at the end of its operational life cycle, although this option has not been totally eliminated from consideration. If such an option were implemented, the proposed SNS site environment would be available for productive uses commensurate with the cleanup levels achieved during site remediation.

Two possible options for retirement of the proposed SNS facility are being actively considered: in situ decommissioning and limited decontamination combined with in situ decommissioning. As a result, use of the 110-acre (45-ha) SNS site and adjacent land for other productive purposes could be limited for an indeterminate number of years beyond the operational life cycle of the SNS. The proposed site lies within the Pine Barrens area of Long Island. The 110 acres (45-ha) represent less than two percent of the Pine Barrens Protection Area. The proposed SNS would be constructed entirely within the Compatible Growth Area of the Pine Barrens, not within the more stringently Protected Core Preservation Area (refer to Section 4.4.8.4).

5.9.5 NO-ACTION ALTERNATIVE

The proposed SNS facility would not be constructed, operated, or closed at any location under the No-Action Alternative. No short-term use of the environment would occur under this alternative. Consequently, such use would have no effect on the long-term productivity of the environment.

5.10 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible and irretrievable commitment of resources associated with the proposed action (SNS siting alternatives) and the No-Action Alternative are presented in Table 5.10-1.

Table 5.10-1. Irreversible and/or irretrievable commitment of resources (proposed SNS facility at 1 MW for 40 years).

Factor	No-Action	ORNL Alternative	LANL Alternative	ANL Alternative	BNL Alternative
Land use					
Land (ac)	0	110	110	110	110
Forested (ac)	0	75±	50±	50±	75±
Construction					
Concrete (yd^3)	0	50,000	50,000	50,000	50,000
Steel Shielding (tons)	0	4,000	4,000	4,000	4,000
Utilities					
Electricity[a] (gWh)	0	10,183	10,183	10,183	10,183
Water[b] (gals)	0	9.4E+09	9.4E+09	9.4E+09	9.4E+09
Steam[c] (lb)	0	0	4.8E+09	4.8E+09	0
Natural Gas (bcf)[d]	0	1.73	NA	NA	2.67
Workforce					
Direct (persons)	0	275	275	275	275
Indirect	0	1,314	1,314	1,314	1,314
Construction	0	2,349	2,349	2,349	2,349

[a] Assume full power for 240 days/yr for 40 yrs at 85%.
[b] Assume continuous 800 gpm (3,028 lpm) use for 240 days/yr for 40 yrs at 85%.
[c] Energy required to produce steam based on APS usage at ANL, adjusted for degree days.
[d] Billion cubic feet - based on 23.565 mcf/hr at ORNL in January, adjusted for degree days.
NA - Not available.

5.11 MITIGATION MEASURES AND MONITORING PLAN

One of the major functions of an EIS is to specify measures that could be taken to mitigate adverse environmental impacts identified through the impact analysis. Mitigation measures may be classified according to three basic categories: (1) measures required by law or regulations; (2) measures that are built into a project from the start to avoid effects; and (3) measures that are developed in response to adverse impacts identified in the environmental impact analyses.

This section summarizes the mitigation measures that may be applied to potential effects associated with each of the alternatives analyzed in this FEIS. Mitigation measures required by law or regulation are not discussed in this section. The applicable laws and regulations that embody such requirements are described in Chapter 6. Also, routine mitigation measures that would be implemented as part of standard practices for construction or operation are not included in the summary. These measures would include practices such as installing silt fences to minimize soil erosion and sediment transport during construction.

<u>When necessary, DOE would implement mitigation measures to minimize the impacts caused by construction and operation of the SNS. DOE would prepare a MAP that will</u>

address mitigation commitments expressed in the ROD. The MAP would present details concerning the planning and implementation of the mitigation measures designed to lessen the impacts associated with the proposed action. DOE would complete the MAP before taking any action directed by the ROD that is subject to a mitigation commitment.

5.11.1 ORNL ALTERNATIVE (PREFERRED ALTERNATIVE)

Measure designed to avoid adverse environmental impacts that would result from implementing the proposed action on the SNS site at ORNL would be incorporated in SNS construction. DOE is committed to implementation of the following avoidance measures:

- A retention basin (approximately 2 acres or 0.81 ha) would be constructed to collect surface water runoff from the proposed SNS site. It would be used to settle sediment particles entrapped in the runoff and to control the rate of water discharge from the basin into White Oak Creek. As a result, effects on stream characteristics and flow, water quality, and aquatic resources downstream from the outfall into White Oak Creek would be minimized.

- Water from the cooling towers would be temporarily collected in the retention basin. The basin would be committed to lowering the temperature of the cooling water prior to its discharge into White Oak Creek. This reduction would minimize the potential effects of elevated water temperatures on the ambient temperature of the creek and temperature-sensitive aquatic resources.

- The cooling water effluent from the proposed SNS facility would be dechlorinated prior to discharge into the retention basin to minimize effects on aquatic resources downstream from the outfall to White Oak Creek.

- The discharge from the retention basin would be routed by pipeline to a White Oak Creek outfall point south of Bethel Valley Road. This pipeline would avoid effects on baseline NPDES monitoring activities, including the ORNL Biological Monitoring and Abatement Program (BMAP), and other ORNL research activities involving the headwaters of White Oak Creek.

- The shielding design of the proposed SNS facility would be modified to minimize neutron activation of the linac berm soils, leaching of radionuclides by groundwater, and subsurface migration of radionuclide contamination. This design would include a crushed limestone interval covered by a geomembrane liner to protect the groundwater and inhibit its flow.

- A continuously forested pathway would be retained along Chestnut Ridge during vegetation clearing to minimize effects on terrestrial wildlife movements.

- A 100- to 200-ft (34- to 68-m) buffer zone of uncleared vegetation would be retained along the headwaters of White Oak Creek near the proposed SNS site to minimize the effects of solar radiation on water temperature and cool water aquatic resources (for example, fish species such as the banded sculpin and blacknose dace).

A number of measures would be taken to mitigate adverse environmental impacts that would result from implementing the proposed action on the SNS site at ORNL. DOE is committed to implementation of the following mitigation measures:

- The effects of elevated continuous noise from the cooling towers and other sources on SNS site personnel and visitors would be minimized with landscape barriers to the extent possible. Such barriers would include the use of trees as sound baffles.

- A small area of wetlands [0.23 acres (0.09 ha)] would be eliminated for the upgrade of Chestnut Ridge Road and areas of other wetlands may be indirectly affected during construction and operation of the proposed SNS. Effects of the proposed action on wetlands would be mitigated by implementing measures to prevent their damage, repair unpreventable damage, or replace eliminated wetlands with an equal or greater amount of man-made wetlands. These man-made wetlands would be as much like the original wetlands as possible and would be placed onsite or in the same watershed. Such mitigative actions would meet the current federal policy calling for no net loss of wetlands as a result of U.S. government activities.

- Appropriate measures would be implemented to protect identified specimens of pink lady's slipper and American ginseng during implementation of the proposed action. On a case-by-case basis, appropriate measures would be taken to protect any other specimens of threatened and endangered species identified during a systematic biological survey of the proposed SNS site that would occur prior to implementation of the proposed action.

- Traffic impacts would be mitigated by improvements to eastbound segments of Bethel Valley Road and southbound segments of State Road 62.

- If radioactive mixed waste generated by the SNS were to exceed the capacity of current storage facilities at ORNL, mitigation measures would have to be taken. Increasing the RCRA-permitted storage capacity at the laboratory would mitigate this.

DOE is considering the following mitigation measures at ORNL but has not yet committed to their implementation:

- Emissions of CO_2 during construction and operation of the SNS would affect TDFCMP measurements by NOAA/ATDD and susceptible ORNL-ESD ecological research projects in the Walker Branch Watershed. The TDFCMP monitoring and ecological research projects may also be affected by water vapor emissions from the cooling towers at the proposed SNS. These effects could be mitigated by relocating the NOAA/ATDD meteorological monitoring tower to a Walker Branch Watershed location less susceptible to the effects of the CO_2 emissions or by building a new tower at this different location.

- Emissions of CO_2 from natural gas boiler stacks during operation of the SNS would affect TDFCMP measurements and susceptible ORNL-ESD ecological research projects in the Walker Branch Watershed. These effects could be mitigated by installing electric heat pumps in the SNS heating system instead of natural gas boilers. This would eliminate CO_2 emissions from the heating system.

The prevention of future impacts after implementation of the proposed action on the SNS site at ORNL would be dependent upon plans for monitoring of the environment. DOE is committed to implementation of the following environmental monitoring measures:

- The groundwater at the proposed SNS site would be routinely monitored for radionuclide contamination.

- Emissions of airborne radioactivity and direct radiation would be routinely monitored throughout the life of the facility. Data gathered over approximately 10 years of operation at 1 MW would be used to evaluate and modify design and operating procedures, as necessary, prior to operation at 4 MW.

5.11.2 LANL Alternative

Measures designed to avoid adverse environmental impacts that would result from implementing the proposed action on the SNS site at LANL would be incorporated into SNS construction. DOE is committed to implementation of the following avoidance measures:

- The shielding design of the proposed SNS would be modified to minimize neutron activation of the linac berm soils, leaching of radionuclides by groundwater, and subsurface migration of the radionuclide contamination. This design would include a crushed limestone interval covered by a geomembrane liner to protect the groundwater and inhibit its flow.

A number of measures would be taken to mitigate adverse environmental impacts that would result from implementing the proposed action on the SNS site at LANL. DOE is committed to implementation of the following mitigation measures:

- The effects of elevated continuous noise from the cooling towers and other sources on SNS site personnel and visitors would be minimized with landscape barriers to the extent possible.

- Appropriate measures would be taken on a case-by-case basis to protect specimens of threatened and endangered (T&E) species identified during a systematic biological survey of the proposed SNS site that would occur prior to implementation of the proposed action.

- Five prehistoric archaeological sites, all eligible for listing on the NRHP, are located on the proposed SNS site. In addition, these sites would be considered to be TCPs by local tribal groups. These sites are within the 65 percent of the proposed SNS site that has been surveyed for cultural resources. These sites would be destroyed during construction of the proposed SNS. This destruction would be mitigated through data recovery operations, consisting primarily of archaeological excavations and detailed architectural recording of the prehistoric structures at the five sites. The remaining 35 percent of the proposed SNS site and a 100-ft (30.5-m) buffer zone around it would be surveyed for cultural resources prior to implementation of the proposed action, if the site at LANL were selected for construction of the proposed SNS facility. Any NRHP-eligible prehistoric or historic cultural resources identified in this area would be subject to the same types of mitigation measures or other more appropriate measures determined on a case-by-case basis.

- DOE-AL has not consulted with Native American and Hispanic groups about the occurrence of other specific TCPs on the proposed SNS site or in its vicinity at LANL. If this site were chosen for construction of the proposed SNS facility, these consultations would be made prior to implementation of the proposed action. Appropriate measures to mitigate effects on any TCPs that may be identified through these consultations would be implemented on a case-by-case basis.

- The solid LLW generated by the SNS would cause a minimal effect on LANL's waste treatment facilities. Alternative treatment methods would have to be considered.

- The sanitary waste generated by the SNS would cause a minimal effect on LANL's waste treatment and disposal capabilities. Alternative treatment and disposal methods would have to be found.

DOE is considering the following mitigation measures at LANL but has not yet committed to their implementation:

- Construction of a dry cooling tower to recycle process water used at the site in an effort to reduce aquifer drawdown.

- Construction of new utility infrastructure would be necessary to support the electrical power demands of the SNS. Additionally, it would be necessary to pursue several regional and multistate strategies to provide a 62-MW supply. These include a new regional (multistate) power grid configuration or possibly an SNS site-specific power generation station.

The prevention of future impacts after implementation of the proposed action on the SNS site at LANL would be dependent upon plans for monitoring of the environment. DOE is committed to implementation of the following environmental monitoring measures:

- Emissions of airborne radioactivity and direct radiation would be routinely monitored throughout the life of the facility. Data gathered over approximately 10 years of operation at 1 MW would be used to evaluate and modify design and operating procedures, as necessary, prior to operation at 4 MW.

5.11.3 ANL ALTERNATIVE

Measures designed to avoid adverse environmental impacts that would result from implementing the proposed action on the SNS site at ANL would be incorporated into SNS construction. DOE is committed to implementation of the following avoidance measures:

- The eastern edge of the proposed SNS site in ANL overlies a portion of the 100-year floodplain along an unnamed tributary of Sawmill Creek. The eastern edge of the proposed SNS site at ANL would overlie a portion of the 100-year floodplain along an unnamed tributary of Sawmill Creek. In addition, the southern tip of the site would encroach on the 100-year floodplain along an unnamed tributary of Freund Brook. Potential effects from flooding would be mitigated in several ways, including filling and stabilization of those portions of the floodplains required for buildings and related structures, alteration of drainage patterns, construction of drainage features (storm drains and canals), and optimizing the placement of buildings and the retention basin to avoid floodplains. With regard to the unnamed tributary of Sawmill Creek, the retention basin would be sized to contain a 100-year flood, replace lost capacity to control floodwater due to disruption of the floodplain, and control runoff to the tributary.

- A retention basin (approximately 2 acres or 0.81 ha) would be constructed to collect surface water runoff from the proposed SNS site. It would be used to settle sediment particles entrapped in the runoff and to control the rate of water discharge from the basin into a small tributary of Sawmill Creek. As a result, effects on stream characteristics and flow, water quality, and aquatic resources downstream from the outfall would be minimized.

- Water from the cooling towers would be temporarily collected in the retention basin. The basin would be committed to lowering the temperature of the cooling water prior to its discharge into the tributary of Sawmill Creek. This reduction would minimize the potential effects of elevated water temperatures on the ambient temperature of the creek and aquatic resources.

- The shielding design of the proposed SNS facility would be modified to minimize neutron activation of the linac berm soils, leaching of radionuclides by groundwater, and subsurface migration of the radionuclide contamination. This design would include a crushed limestone interval covered by a geomembrane liner to protect the groundwater and inhibit its flow.

- A 100 to 200-ft (30 to 68-m) buffer zone of uncleared vegetation would be retained around Freund Brook to minimize surface water runoff and the effects of sediment loading on bottom-dwelling fauna.

A number of measures would be taken to mitigate adverse environmental impacts that would result from implementing the proposed action on the SNS site at ANL. DOE is committed to implementation of the following mitigation measures:

- The effects of elevated continuous noise from the cooling towers and other sources on SNS site personnel and visitors would be minimized with landscape barriers to the extent possible. Such barriers would include the use of trees as sound baffles.

- Approximately 3.5 acres (1.4 ha) of wetlands would be eliminated during construction of the proposed SNS. These wetlands are located on the proposed SNS site in ANL. Additional wetlands in the vicinity of the proposed SNS site would be temporarily affected during construction. These effects would be mitigated by implementing measures to prevent their damage, repair unpreventable damage, or replace eliminated wetlands with an equal or greater amount of man-made wetlands.

These man-made wetlands would be as much like the original wetlands as possible. Such mitigative actions would meet the current federal policy calling for no net loss of wetlands as a result of U.S. government activities.

- Appropriate measures would be taken on a case-by-case basis to protect specimens of threatened and endangered species identified during a systematic biological survey of the proposed SNS site that would occur prior to implementation of the proposed action.

- The eligibility of 11DU207 for listing on the NRHP has not been assessed by ANL. If the proposed SNS site at ANL were chosen for construction of the SNS, this assessment would be made prior to the initiation of construction-related activities on the site. If the assessment indicates that 11DU207 is an NRHP-eligible cultural resource, appropriate measures would be implemented to mitigate effects from the proposed SNS facility. These measures would include avoidance, if possible, or archaeological excavation.

- The remaining support services operations in the 800 Area would be displaced by construction of the proposed SNS. This land use effect would be mitigated by transferring these operations to another area of ANL.

- The footprint for the SNS overlays Westgate Road. Approximately 1 mile (1.6 km) of this road would be relocated to the north to circumvent the proposed SNS site and replace the existing Westgate Road access.

The prevention of future impacts after implementation of the proposed action on the SNS site at ANL would be dependent upon plans for monitoring of the environment. DOE is committed to implementation of the following environmental monitoring measures:

- The groundwater at the proposed SNS site would be routinely monitored for radionuclide contamination.

- Emissions of airborne radioactivity and direct radiation would be routinely monitored throughout the life of the facility. Data gathered over approximately 10 years of operation at 1 MW would be used to evaluate and modify design and operating procedures, as necessary, prior to operation at 4 MW.

5.11.4 BNL ALTERNATIVE

Measures designed to avoid adverse environmental impacts that would result from implementing the proposed action on the SNS site at BNL would be incorporated into SNS construction. DOE is committed to implementation of the following avoidance measures:

- A retention basin (approximately 2 acres or 0.81 ha) would be constructed to collect surface water runoff from the proposed SNS site. It would be used to settle sediment particles entrapped in the runoff and to control the rate of water discharge from the basin into the Peconic River. As a result, effects on stream characteristics and flow, water quality, and aquatic resources downstream from the outfall into the river would be minimized.

- Water from the cooling towers would be temporarily collected in the retention basin. The basin would be committed to lowering the temperature of the cooling water prior to its discharge into the Peconic River. This reduction would minimize the potential effects of elevated water temperatures on the ambient temperature of the creek and temperature-sensitive aquatic resources.

- The cooling water effluent from the proposed SNS facility would be dechlorinated prior to discharge into the retention basin to minimize effects on aquatic resources downstream from the discharge outfall to the Peconic River.

- The discharge from the retention basin would be routed by pipeline to an outfall point on the Peconic River. This outfall would be located near the current outfall for the STP. Routing the discharge to this location would avoid effects on wetlands located upstream from the outfall.

- A minimum 300-ft (91-m) buffer zone of uncleared vegetation would be retained between the proposed SNS site and the Peconic River to minimize surface water runoff, sediment loading, and effects on aquatic resources.

A number of measures would be taken to mitigate adverse environmental impacts that would result from implementing the proposed action on the SNS site at BNL. DOE is committed to implementation of the following mitigation measures:

- The effects of elevated continuous noise from the cooling towers and other sources on SNS site personnel and visitors would be minimized with landscape barriers to the extent possible. Such barriers would include the use of trees as sound baffles.

- Appropriate measures would be implemented to protect identified specimens of spotted wintergreen, bayberry, and swamp azalea (state-protected species) during implementation of the proposed action. On a case-by-case basis, appropriate measures would be taken to protect any specimens of threatened and endangered species identified during a systematic biological survey of the proposed SNS site that would occur prior to implementation of the proposed action.

- A number of earthen features at Stations 2, 4, 8, and 10 on the proposed SNS site at BNL may have been used for World War I trench warfare training at Camp Upton. These features are potentially eligible for listing on the NRHP. They would be destroyed during construction of the proposed SNS facility. This effect would be mitigated through data recovery, which would consist of archaeological excavation.

- Hazardous waste generated by the proposed SNS facility would exceed the capacity of current RCRA storage facilities at BNL. This exceedance would be mitigated by increasing the permitted storage capacity for hazardous waste at the laboratory.

- Solid and liquid low-level radioactive waste generated by the proposed SNS facility would exceed the capacity of current storage facilities at BNL. This would be mitigated by increasing the permitted storage capacity for these wastes at the laboratory.

- Mixed waste generated by the proposed SNS facility would exceed the capacity of current RCRA storage facilities at BNL. This would be mitigated by increasing the permitted storage capacity for mixed waste at the laboratory.

- The liquid and solid hazardous wastes generated by the SNS would exceed BNL's current storage capacity. Storage facility capabilities must be expanded to increase RCRA-permitted storage capacity to accommodate the storage of these future wastes.

- The liquid and solid low-level radioactive wastes generated by the SNS would exceed BNL's current storage capacity. Storage facility capabilities must be expanded to increase RCRA-permitted storage capacity to accommodate the storage of these future wastes.

- The liquid and solid mixed wastes generated by the SNS would exceed BNL's current storage capacity. Storage facility capabilities must be expanded to increase RCRA-permitted storage capacity to accommodate the storage of these future wastes.

DOE is considering the following mitigation measures at BNL but has not yet committed to their implementations:

- The constructed proposed SNS facility at BNL would sit only 20 ft (6.1 m) above the sole source aquifer for Long Island. The sandy soils on the proposed SNS site are highly permeable, forming a rapid vertical migration route from a contaminated area of soil to the aquifer. Because of the potential for neutron activation of linac berm soil during SNS operations, a complex multilayer shielding design would be implemented on the proposed SNS site. This shielding would minimize neutron activation of the berm soils, leaching of radionuclides by groundwater, and subsurface migration of the radionuclide contamination.

The prevention of future impacts after implementation of the proposed action on the SNS site at BNL would be dependent upon plans for monitoring of the environment. DOE is committed to implementation of the following environmental monitoring measures:

- The groundwater at the proposed SNS site would be routinely monitored for radionuclide contamination.

- Emissions of airborne radioactivity and direct radiation would be routinely monitored throughout the life of the facility. Data gathered over approximately 10 years of operation at 1 MW would be used to evaluate and modify design and operating procedures, as necessary, prior to operation at 4 MW.

5.11.5 NO-ACTION ALTERNATIVE

The proposed SNS facility would not be constructed or operated at any location under the No-Action Alternative. Consequently, no environmental effects would occur as a result of this alternative, and no mitigation measures would be required.